North Shore Restoration Project

Silviculture Report

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For:
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[insert date]

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1.0 Introduction

This analysis for forest vegetation focuses on how each alternative would affect the tree composition, structure and function of the forest stands in the North Shore Restoration Project (NSRP) area and how these effects would meet the purpose and need, the Mendocino National Forest Land Management Plan (LRMP), Forest Service policy, and federal law. Additionally, the methodology for how trees would be identified as dead or dying is disclosed. The analysis for hazard fuel load is briefly summarized and more specifically analyzed in the fuels report. The effects of the previously approved roadside hazard tree abatement (HTA) categorical exemption will not be analyzed here; however, the HTA project area within the NSRP area will be included as part of the project area subjected to reforestation, and the HTA area is accounted for in cumulative effects analysis as appropriate in the various specialist's reports.

2.0 Regulatory Framework

The Mendocino National Forest Land and Resource Management Plan (LRMP) provides standards and guidelines for fuels reduction and habitat enhancement treatments. In addition, National Forest management is guided by various laws, regulations, and policies that provide the framework for all levels of planning. Guidance is provided in Regional Guides, and site-specific planning documents such as this report. Higher-level documents are incorporated by reference and can be obtained from Forest Service offices. Project-specific ,planning and environmental analysis applicable to silviculture on NFS lands in the Project area include, but are not limited to, the following:

Regulatory Acts:

Section 106 of the National Historical Preservation Act of 1966

The National Environmental Policy Act of 1969

Clean Air Act (CAA) of 1970

Section 7(a)(1) of the Endangered Species Act of 1973

Forest and Rangeland Renewable Resources Planning Act (RPA) of 1974 (as amended) and National Forest Management Act (NFMA) of 1976 (as amended): The Forest and Rangeland Renewable Resources Planning Act of 1974 as amended by the National Forest Management Act of 1976 states that "it is the policy of the Congress that all forested lands in the National Forest System shall be maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth, and conditions of stand designed to secure the maximum benefits of multiple use sustained yield management in accordance with land management plans."

Forest Service Regulations:

The Record of Decision (ROD) and Standards and Guidelines (S&Gs) for Management of Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Northern Spotted Owl (USDA/USDI 1994)

Forest Service Manual FSM 2470: Forest Service Manual 2470 directs that silviculture examinations, treatment diagnosis, and detailed prescriptions be prepared for all forest treatments (USDA 2004b).

Forest Service Manual FSM 3400: Forest Service Manual 3400 directs that it is the policy of the Forest Service to include forest health considerations in forest resource management planning and decision making. Forest supervisors and district rangers have the responsibility to ensure full consideration of forest health issues in resource management activities.

The National Fire Plan (USDA and USDI 2000d): The National Fire Plan was recommended in a report to the President in September 2000 and subsequently adopted by the Forest Service in conjunction with other federal wildland management agencies and published in the Federal Register on November 9, 2000. The purpose of the plan is to:

Improve the resilience and sustainability of forests and grasslands at risk

Conserve priority watersheds, species, and biodiversity

Reduce wildland fire costs, losses and damages

Better ensure public and firefighter safety

The Mendocino National Forest Land and Resource Management Plan of 1995 (includes Standards and Guidelines from the Northwest Forest Plan)

Watershed Analysis report for the North Fork Cache Creek Watershed Assessment, (May 1996) and the Upper Lake Watershed Analysis (September 1999).

State Regulations:

Manage National Forest activities to maintain air quality at a level which meets or exceeds State and/or local government regulations.

2.1 Forest Plan Management Direction

National Forest management is guided by various laws, regulations, and policies that provide the framework for all levels of planning. The Mendocino National Forest Land and Resource Management Plan, (LRMP) (1995) provides the direction for management activities on the Mendocino National Forest. The plan identifies specific management area direction representing the desired future condition that management actions are designed to achieve. LRMP Management Direction includes Forest Goals, Standards and Guidelines, Management Prescriptions, Management Areas, and Supplemental Management Area Direction. Compliance with this direction is required for any action taken on the Mendocino National Forest.

Forest management direction is implemented through management prescriptions and adherence to LRMP standards and guidelines. "Management prescriptions provide the linkage between management direction and specific land areas, and they provide direction in addition to the Forest-wide standards and guidelines" (LRMP, p. IV-55). The LRMP Management Prescriptions for this project include RX 3 -- Chaparral Management, RX 4 – Minimal Management, RX 6 – Late-Successional Reserve, and RX 7 – Timber Modified.

2.1.1 RX 3--Chaparral Management

The purpose of this prescription is to provide a rotational prescribed burning program or other vegetation treatment technique to accomplish the chaparral forest goal. The Chaparral forest goal is to: "Bring suitable chaparral lands under management to capture potential range, wildlife, recreation, and watershed benefits and to reduce the risk of large costly wildfires" (LRMP, IV-2).

The management direction and associated standards and guidelines emphasis is to: "Locate and design prescribed burns using an interdisciplinary approach, to protect and conserve botanical diversity, viability of sensitive plant species and populations, wildlife habitat, watershed values, and other resource values as appropriate to specific project sites. (LRMP IV-58).

2.1. 2 RX 4 – Minimal Management

This prescription is to be applied to riparian reserves. Treatment units contain 5093 acres associated with riparian reserves.

To achieve the Riparian and Aquatic Ecosystems forest goal, the LRMP has designated Riparian Reserves (RRs) to be managed under the Minimal Management prescription. The LRMP standards and guidelines establish appropriate conditions to allow timber harvest within Riparian Reserves. They are to: "Apply silvicultural practices for riparian reserves to control stocking, reestablish and manage stands, and acquire desired vegetation characteristics needed to attain aquatic conservation strategy objectives" (LRMP, IV-35).

2.1.3 RX 6 - Late-Successional Reserves (LSR)

The purpose of this prescription is to provide for the viability of the northern spotted owl and other species dependent on older mature forested habitats, including, but not limited to, goshawk, marten and fisher.

Silvicultural systems proposed for Late-Successional Reserves have two principal objectives. (1) development of old-growth forest Characteristics including snags, logs on the forest floor, large trees, and canopy gaps that enable establishment of multiple tree layers and diverse species composition; and (2) prevention of large-scale disturbances by fire, wind, insects, and diseases that would destroy or limit the ability of the reserves to sustain viable forest species populations. Small-scale disturbances by these agents are natural processes, and will be allowed to continue. (FSEIS ROD p. B-5)

Note: Within the project area there are three 100 acre LSR's, and no specific large land area with the LSR land allocation. The three 100 acre LSR's burned at very high fire severity. Portions of two of the three 100 acre LSR's will be treated by salvage operations to remove fire killed or injured trees. The other 100 acre LSR treatment will follow Fire and Fuel prescription to reduce fuel loading.

2.1.4 RX 7 - Timber Modified

This prescription provides emphasis on timber production while providing for other resource objectives including visual quality, watershed, rare and endemic species, and wildlife. This prescription applies to treatment units 18, 29 and portions of 23 totaling 184 acres.

The Timber Modified prescription provides management of "capable, available, and suitable timberlands found outside of wilderness, wild & scenic rivers, backcountry areas, RNAs, and riparian reserves" (LRMP, IV-69). The objective for these lands is to manage with an "emphasis on timber production while providing for other resource objectives including visual quality, watershed, rare and endemic species, and wildlife." (LRMP, IV 69). Management Direction for suitable timberland under the Timber Modified management prescription calls for the regulation of "… all timber yields from suitable timber lands" and to "Intensively manage timber stands for control of competing vegetation, stocking control, etc." (LRMP, IV-70).

In addition, Congress establishes timber harvest targets for the Forest Service in annual appropriations, and individual national forests are assigned their portion of the targets based, in part, on the allowable sale quantity established in each forest's LRMP. The Mendocino National Forest's LRMP established an allowable sale quantity of 2.2 million cubic feet (14.8 million board feet) for the second decade (LRMP, IV-14). The North Shore Restoration Project would contribute to the Mendocino National Forest's annual sale target in the year it is sold.

2.1.5 Fire and Fuels

In addition, to the management direction provided by the management prescriptions discussed above, the LRMP has established Forest Goals and standards and guides that pertain to fire and fuels management. The fire and fuels forest goal: "Maintain a cost effective detection, prevention, suppression, and fuels management program mix in support of other resource programs" (LRMP, IV-2).

In order to accomplish that goal, the LRMP emphasizes "fuel treatment efforts for fire hazard reduction purposes in the following areas:

Natural fuels:

Continuous, mature brush stands of more than 150 acres adjacent to or within areas of urban interface, resource investments, or high fire hazards;
Continuous, mature brush stands more than 25 years old;
Continuous, mature brush stands with dead-to-live ratios greater than 35%.
Forested areas with excessive accumulations of natural fuels.

Activity fuels:

In zones of urban interface or other high fire hazard areas;

Where treatment is necessary before initiating other multi-resource management projects, e.g., reforestation (LRMP IV-21).

2.2 Additional Data Sources

Data used in this analysis included:

Property boundaries

Treatment area boundaries

Project area boundaries

Historic Fire Activity

Management Area boundaries

Watershed Analysis report for the North Fork Cache Creek Watershed Assessment, (May 1996) and the Upper Lake Watershed Analysis (September 1999).

Lake County Wildfire Protection Plan (2009);

Site visits have occurred throughout the EA preparation process to assess vegetative conditions. Site visits have included representatives of the U.S. Fish and Wildlife Service and interested members of the public. Site visits were conducted by Forest Service personnel and consulting experts in the following areas: forest ecology, forestry, fire and fuels management, fisheries, forest pest management, hydrology, recreation, scenic management, silviculture and wildlife.

03.0 Resource Indicators and Measures

Number of acres suitable for timber production where forest products are removed to reduce fuels buildup of fire killed or injured trees.

Number of acre suitable for tree planting where forest products are proposed for removal or have been remove in the past.

Number of acres treated to reduce fuel loading in vegetation type not associated with timber production.

Refer to Table 1.

Table 1: Resource indicators and measures for assessing effects

Resource element	Resource indicator	Measure (quantify if possible)	Source (LRMP S/G; law or policy, BMPs, etc.)?
Fire Killed or Injured Trees	Number of tons per acres where removal of fire killed or Injured trees reduce future fuel loading	Tons per Acres	LRMP S/G; law or policy
Tree Seedlings	Number of acre identified for Reforestation	Acre	LRMP, Law Regulation or Policy.
Forest and Chaparral Fuels Management	Number of Acre identified for treatment	Acre	LRMP, Law Regulation or Policy

4.0 Affected Environment Silviculture/Vegetation

Location: The North Shore Restoration project area is located within the Mendocino National Forest, Upper Lake Ranger District, mostly within the 2018 Ranch Fire perimeter. All the project area is within the Berryessa-Snow Mountain National Monument and the Wildland Urban Interface (WUI).

Acreage: The project area consists of approximately 40,000 acres.

Geography: Elevations range from 1400 to 4800 feet. Topography is characterized by moderate to steep slopes, flat bench like mid slope terraces, rock out crops, gentle to steep ridge tops; as well as, subdued gentle basins. Topographical features will serve to assist, restrict, limit, or preclude restoration activities. Soils in the project area were developed from the Franciscan Assemblage. The Soil Survey of Lake County, California classified 36 soil complexes within the project area. Five complexes are associated with the salvage treatment units and thirteen are associated with the reforestation units.

Bioregion: The project area is located within the southern portion *mid montane ecological zone* of the Klamath bioregion, an area of diverse conifer and woodland species. Historic vegetation community dynamics within the mid- to upper-montane zone are believed to have been influenced by a fire regime characterized by fairly frequent low and mixed severity fires that created an open understory mixed conifer forest habitat across the project landscape. (Skinner et al. 2006)

Plant Community Classification and Identification: Plant communities associated with the project are classified according to structure type, (tree, shrub, or herbaceous) and dominance of taxa. A plant community is a recognizable and complex assemblage of plant species which interact with each other as well as with the elements of their environment and is distinct from adjacent assemblages. There are a number of common sub-classifications of plant communities these sub-classifications include, forest, chaparral, riparian, and grassland, etc., which are further divided into more specific classifications. These more specific classifications are referred to as vegetation types. They are based on the dominant tree, shrub, or herb in that canopy. The name given to each is often the common name of the dominant and co-dominant taxa coupled with the sub-classification type. Examples of these within the project area are Sierra Mixed Conifer, Chamise-Redshank Chaparral, Closed-Cone Pine-Cypress (Knobcone Pine), and Annual or Perennial Grassland. Project area plant communities may occur as relatively obvious divisions between each other, or may overlap and have transition zones called ecotones that grade into one another. Ecotones may vary in size and species composition, containing elements of each of the bordering communities. Whatever characteristics specific ecotones may have, this report will identify vegetation type changes on the broader categorization, plant communities.

Vegetation Types: The Project area contained a variety of vegetation types. The California Wildlife Habitat Relationship (CWHR) system identified eighteen different vegetation types. These types where present in varying concentration from grassland, pure chaparral stands to a combination of chaparral – hardwood, conifer – hardwood, or mixed conifer associations Most of the acreage in the project area burned under hot, windy conditions creating a mosaic of live and dead vegetation. The mosaic features higher severity areas where nearly all vegetation is dead and lower severity areas where a mixture of dead and live vegetation is present. Also, within the mosaic green islands are present. (Refer to Table 2 for CWHR vegetation type code. Refer to Table 4-7 for information concern vegetation types and fire severity.)

Table 2: WHR Vegetation types and Corresponding Three Letter Type Code

CWHR* TYPE CODE	Vegetation Type
BOP	Blue Oak-Foothill Pine
BOW	Blue Oak Woodland
COW	Coastal Oak Woodland
CPC	Closed-Cone Pine-Cypress
DFR	Douglas Fir
MHC	Montane Hardwood-Conifer
MHW	Montane Hardwood
PPN	Ponderosa Pine
SMC	Sierran Mixed Conifer
VOW	Valley Oak Woodland
AGS	Annual Grass
CRC	Chamise-Redshank Chaparral
MCH	Mixed Chaparral
MCP	Montane Chaparral
MRI	Montane Riparian
PAS	Pasture
WTM	Wet Meadow

*California Wildlife Habitat Relationship

Reforestation: Because no trees survived in so much of the burned area in many locations there are very limited seed sources for natural regeneration.

Timber Resource: Large stands of economically valued tree species such as Douglas-fir were killed in the Ranch Fire. Within two to three years post-fire, these trees lose economic value due to insect damage, staining due to fungal infections, and checking (cracks in the wood that occur as the burned wood dries). Capturing the value of burned timber enables the National Forest System (NFS) to contribute to local economies, provide wood products to society, and fund needed restoration and hazard reduction activities.

Fuel loading: The innumerable fire-killed trees if left untreated will contribute to extremely high fuel loading over time. Topographic operational limitations will limit or prevent reduction through removal treatments. Untreated areas have the potential to contribute to extremely high fuel loading. The Fuel loading will result in increased potential wildfire intensity, and jeopardize the ecosystem's ability to recover.

Green Island: Green islands are areas where low to moderate fire severity that did not create substantial mortality to the vegetative resource. These areas have been identified as high value areas in term of remaining green habitat areas. They will be treated for fuel reduction within these areas, as well as; a feathered thinning treatment buffer applied to the immediately surrounding area. Refer to Figure 1, notice the small green island in the center and Figure 2 the green island in center and extending to the left. (Refer to the fuels report for a more detailed explanation.)

Figure 1: Green Island

Climate: The potential effects of increasing temperatures and altered precipitation regimes resulting from climate change may reshape ecosystem recovery processes. Restoration of pre-fire plant alliances may be difficult in some parts of the burn area.

4.1 Existing Condition

Project Area Vegetation Types

The existing conditions of the vegetative resources are organized around the ecological environments depicted by vegetation type present. The following information is presented for each vegetation type that exists or was present pre-fire within the project area, and is addressed in terms of its burn severity which represents the existing conditions.

Post Fire Burn severity

The Ranch fire burned with varying intensity across the landscape. Fire behavior in some locations ranged from creeping and smoldering to group torching, but the vast majority of the fire behavior was a fast moving crown fire. Five mortality classes have been identified and used to describe the post-fire vegetation conditions. These classes are described as follows:

Unburned (Burn severity rate of 0 percent basal area loss) contiguous areas within the fire perimeter that did not experience fire.

Low (Burn severity rates of 0-24 percent) result from low severity fires where typically duff and ground vegetation were lightly burned, many areas of unburned ground vegetation remain throughout the stand, and less than 25 percent of the dominant and co-dominant overstory trees were killed by the wildfire.

Mixed (Burn severity rates of 25-49 percent basal area loss) result from fires ranging from moderate severity in stands of mostly unburned overstory trees and low-to-moderate duff reduction and mortality in the ground vegetation to moderately high severity fires that can significantly reduce much of the duff, burning the tops of a large portion of the ground vegetation, and killing up to 49 percent of the overstory trees. The result is a mosaic that can include islands of green trees intermixed with scattered clumps of dead and live trees.

High (Burn severity rates of 50-74 percent basal area loss) result from high severity fire occurring in which the duff and tops of the ground vegetation was nearly all consumed, leaving a quarter or less unburned or lightly burned, and from 5 to 75 percent of the trees were killed. These areas experienced fire intensities that resulted in fire effects ranging from complete crown scorch to consumption of fine twigs and needles on standing trees.

Very High (Burn severity rates of 75-100 percent basal area loss) similar fire effects as experienced under high with up to 100 percent of the trees being killed. Extensive duff and ground vegetation burned to exposed soil conditions.

Change in vegetation structure and species composition within the NSRP area is most prevalent in the very high mortality class. Within the project area, this class accounts for approximately 76 percent of the area. Burn severity resulting in vegetation mortality 75 percent or greater essentially resets the successional stage. Burn severity at this rate effectively removes all mid to late successional habitat leading to the development of new structure of an early successional stage. At this stage grass/forb/ tree or shrub seedling becomes the dominate vegetation. Important to recognize is that the other burn severity classes result in only 9 percent in the high severity class, 7 percent experienced mixed severity, while 3 percent with low severity and 4 percent was unburned.

Table 3 represents project area burn severity by burn severity class in term of basal area loss and the number of acres within each class. Figure 2 is a picture taken from Forest Road 14N01 looking northeast. The second ridge in is Long Valley ridge, the typical vegetation pattern is shrubland on the south facing slopes leading to conifer, hardwood, or conifer hardwood forestland on some extensive ridgetop areas, north facing slope, or within lower portions of canyon draws. The wildfire burned beyond the last ridge visible on the horizon.

Table 3: Project Area Burn Severity by Burn Severity Class and Acres

Burn Severity Classes	Burn Severity within Project Area by Acres and Percent of Project Area in Each Class	
	Acres	Percent Project Area
No Loss 0%	1791	4%
Low 0-24%	1335	3%
Mixed 25-49%	2750	7%
High 50-74%	3656	9%
Very High 75-100%	30277	76%

Figure 2: Looking Northeast from 14N01

Table 4 represents the Conifer project area burn severity classes expressed in percent basal area loss within the dominate conifer vegetation types. The severity of the impact is expressed in the two following photos (Figure 3 and Figure 4).

Table 4 Dominate Conifer Vegetation Type

Burn Severity Classes	Percent Burn Severity Area by CWHR* Vegetation Cover Types							Total
	Dominant Conifer Vegetation Type							Percent
	DFR		PPN		SMC			Basal
	Acres	Area %	Acres	Area %	Acres	Area %	Total Acres	Area Loss
No Loss 0%	0	0%	67	5%	73	3%	**140**	**3%**
Low 0-24%	56	8%	153	11%	175	8%	**384**	**9%**
Mixed 25-49%	110	15%	282	20%	334	15%	**726**	**17%**
High 50-74%	116	16%	269	19%	348	16%	**733**	**17%**
Very High 75-100%	440	61%	665	46%	1246	57%	**2351**	**54%**
Grand Total	**722**		**1436**		**2176**		**4334**	

*California Wildlife Habitat Relationship

Figure 3: Cruise Plot #6 2010

Figure 4: Cruise Plot #6 2019

Figure 3 photo was taken in 2010 at a plot center located by GPS as part of the information developed for the Lakeview Hazardous Fuels Reduction Project. Burn char on trees, large diameter trees on ground and the associated smaller diameter CWD are all results of the 1996 Fork Fire. No salvage operations were conducted post Fork fire at this location resulting in the heavy fuel loading. Fuel treatments, as part of the Lakeview project, were planned to reduce the fuel load, but not implemented. Figure 4 is taken from the same plot center post Ranch fire. The fuel loading contributed to the very high intensity fire that killed all trees visible in the picture and consumed all surface fuel, duff layer and leaving bare soil conditions. Surface debris currently visible on ground is from Ranch fire killed trees.

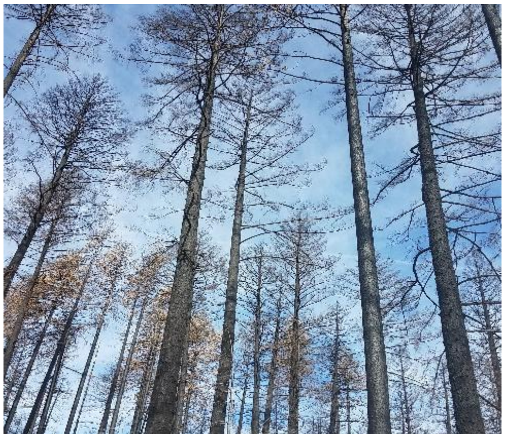


Figure 5: Very High Fire/High severity comparison Figure 6: Mixed/Low severity burn.

Figure 5 represents the typical conifer vegetation existing condition where 54 percent of that vegetation type acreage burned at very high intensity and 17 percent burned at high intensity. Whereas, Figure 6 represent the typical conifer vegetation existing condition where 17 percent of the vegetation type acreage burned at mixed severity and 9 percent burned at low severity.

Table 5 represents the project area burn severity classes expressed in percent basal area loss within the closed-cone-pine vegetation type. The dominate species present is knobcone pine.

Table 5: Closed-Cone-Pine Vegetation Type (Knobcone Pine).

Burn Severity Classes	Percent Burn Severity Area by California Wildlife Habitat Relationship Vegetation Cover Types — Closed-Cone-Pine-Cypress Forest Vegetation Types — CPC: Acres	Area %	Total Acres	Total Percent Basal Area Loss
No Loss 0%	36	1%	36	**1%**
Low 0-24%	18	1%	18	**1%**
Mixed 25-49%	60	2%	60	**2%**
High 50-74%	121	4%	121	**4%**
Very High 75-100%	2612	92%	2612	**92%**
Grand Total	**2847**		**2847**	

Figure 7: Knobcone foreground, middle ground shrub cover, background knobcone.

Figure 8: Knobcone Stand 1 year post fire winter 2019-2020

Figure 9: Knobcone Stand 1 year post fire winter 2019-2020

Figures 8 and 9 demonstrate the potential impacts to fuel loading from a vegetation type that is known for high density of knobcone trees per acre. Knobcone pine structural strength weakens quickly resulting in a short snag retention period. Refer to the Fire and Fuels Report for more information.

Knobcone pine is a strongly serotinous species that reproduces only from seed (Rielly et al, 2019). This species is commonly associated with a developmental pathway characterized by establishment at high densities following stand-replacing fire (Keeley et al., 1999). In the absence of subsequent fires, longer-lived, more shade-tolerant species eventually replace knobcone pine as individual trees senesce and die (Vogl, 1973; Zedler et al., 1983; Fry et al., 2012). Knobcone pine may be found in pure stands following high-severity fire or in mixed stands with many other longer-lived conifer and hardwood species.

Figure 10: Fire Killed Knobcone mixed with black oak sprouts and knobcone seedlings

Knobcone pine may also be found interspersed with and along the border of chaparral vegetation. As a result of the Ranch fire, the existing conditions are being influenced by the expansion of knobcone seedling into the bordering fire killed chaparral vegetation areas.

Figure 11: Knobcone seedling expanding into bordering shrubland.

Knobcone pine trees are short lived rarely live more than 80 years (Howard, 1992). They may begin producing cones as early as 4–14 years of age and can continue producing viable seed past age 70 (Fry and Stephens, 2013).

Table 6 shows the project area by burn severity classes within the Hardwood Forest Vegetation.

Table 6 Hardwood Forest Vegetation Types

Burn Severity Classes	Percent Burn Severity Area by California Wildlife Habitat Relationship Vegetation Cover Types — Hardwood Forest Vegetation Types													Total Percent Basal
	BOP		BOW		COW		MHC		MHW		VOW			
	Acres	Area %	Acres	Area %	Acres	Area %	Acres	Area %	Acres	Area %	Acres	Area %	Total Acres	Area Loss
No Loss 0%	59	13%	25	10%	5	10%	113	3%	385	5%	2	1%	**589**	**4%**
Low 0-24%	16	3%	2	1%	0	0%	238	7%	437	6%	26	8%	**719**	**5%**
Mixed 25-49%	44	9%	33	13%	4	8%	473	14%	782	11%	75	24%	**1411**	**10%**
High 50-74%	54	12%	69	27%	8	17%	513	15%	956	13%	83	27%	**1683**	**12%**
Very High 75-100%	293	63%	124	49%	31	65%	1983	60%	4734	65%	127	41%	**7292**	**50%**
Grand Total	**466**		**253**		**48**		**3320**		**7294**		**313**		**11694**	

Figure 12: Montane Harwood vegetation type

Table 7 shows the project area by burn severity classes within the grassland and shrubland Vegetation Types. (Note: The following table is based on canopy cover loss.)

Table 7: Grassland and Shrubland Vegetation Types.

Burn Severity Classes	Percent Burn Severity Area by Forest Vegetation Cover Types / Grassland and shrubland Vegetation Types											Total Percent Canopy
	AGS	%CC Loss	CRC	%CC Loss	MCH	%CC Loss	MCP	%CC Loss	URB	%CC Loss	Total Acres	Cover Loss
No Loss 0%	168	11%	328	7%	816	6%	37	2%	11	8.59%	**1360**	**6%**
Low 0-25%	139	9%	48	1%	422	3%	33	2%	2	1.56%	**645**	**3%**
Mixed 25-49%	133	8%	43	1%	350	2%	39	2%	9	7.03%	**574**	**3%**
High 50-74%	163	10%	55	1%	413	3%	45	3%	18	14.06%	**695**	**3%**
Very High 75-100%	980	62%	4420	90%	12239	86%	1465	90%	88	68.75%	**19192**	**86%**
Grand Total	**1583**		**4895**		**14240**		**1619**		**128**		**22466**	**100%**

Figure 13: Shrubland vegetation consisting of chemise and manzanita.

This picture shows a vegetation transition from the chemise redshank chaparral vegetation type to a mixed chaparral vegetation type. As time passes the existing condition of standing dead shrubs will present a fuel loading problem.

4.2 Desired Condition

The desired future condition (DFC) is a resilient landscape with a mix of species composition, structure, and function that ensure long-term sustainability, forest growth and productivity, and resistance and resilience to stressors (e.g., climate change, fire, pathogens) as required by National Forest Management Act (NFMA), Land and Resource Management Plan (LRMP), and Forest Service policy.

The vegetation resource desired condition will follow the appropriate management prescription for the three management areas associated with the NSRP.
These areas are Bartlett, Middle Creek and Ruppert. Management prescription appropriate for these areas are found in Table 8 below.

Table 8: Management Prescription (Rx)

NSRP LRMP Management Areas	LRMP MANAGEMENT PRESCRIPTION	Basic Vegetation Type	Vegetation Management Goals
Bartlett	Rx-1, Rx-3, Rx-4, Rx-6	Hardwood, Chaparral, Conifer	Seral Stage Diversity
Middle Creek	Rx-1, Rx-3, Rx-4, Rx-6	Hardwood, Chaparral, Conifer	Seral Stage Diversity
Ruppert	Rx-1, Rx-3, Rx-4, Rx-6, Rx7, Rx12	Hardwood, Chaparral, Conifer	Seral Stage Diversity

Suitable Lands

Identification of lands generally suitable for timber harvest and timber production is made at the land management plan level; however, these identifications are estimates that are validated at the project level (36 CFR 219.12(a)(2)(D)(ii). Project-level suitability determinations were made during silvicultural diagnoses; final suitability determinations on lands proposed for commercial timber harvest would be documented in a site-specific silvicultural prescription prepared or reviewed by a Certified Silviculturist.

Timber harvest on lands not suitable for timber production can occur when harvest is necessary or appropriate for other multiple use purposes and to achieve the desired vegetation conditions (16 USC 1604 (k), 36 CFR 219.12(a)(2)(D)(ii)). This is consistent with 16 USC 1604 (k) and 36 CFR 219.12(a)(2)(D)(ii) the implementing regulations of the National Forest Management Act of 1976.

5.0 Environmental Consequences

5.1 Methodology

The methods, information sources, science and assumptions that are used for the analysis in this report are noted in individual sections of the report.

Current condition data for the potential salvage, reforestation and fire and fuels operations were derived from the Rapid Assessment of Vegetation Condition after Wildfire (RAVG) program which assesses post-fire vegetation condition for large wildfires on forested National Forest System (NFS) lands. In addition, the Northern Province Ecology Program (NPEP) advisors where consulted concerning conifer regeneration potential. RAVG information is used to assist in post-fire vegetation management planning. The information is intended to enhance decision-making capabilities and reduce planning and implementation costs associated with post-fire vegetation management. The NPEP applied a spatially-explicit model developed by Shive et al. (2018) to produce a predictive map of potential conifer regeneration following the 2018 Ranch Fire on the Mendocino National Forest. This RAVG approximation NPEP predictive map were followed by site-specific diagnosis and development of a silvicultural prescription to more precisely identify treatment needs.

As part of the research project lead by Morris Johnson of the Pacific Northwest Experiment station, the Forest Vegetation Simulator (FVS) and the Fire and Fuels Extension (FFE) of FVS were used to simulate post-fire conditions for the potential buildup of surface fuels over time. Information on fire killed trees as they contribute to down wood was derived from stand exams data collected. FVS is a firmly established tree and stand growth model that is fully supported and maintained by the Forest Service (Dixon 2002).

5.2 Incomplete and Unavailable Information

Stand inventory data was not developed for the entire project area, but silvicultural prescriptions where developed following guidance from the Marking Guidelines for Fire-Injured Trees in California (Smith and Cluck 2011).

There is expectation that additional fire caused tree mortality will occur over time due to potential subsequent bark beetle infestations. This type of mortality is difficult to predict, therefore the salvage units were based first on existing fire mortality where a high percentage of the existing stand has been fire killed, and second the possibility of further mortality developing within stands with lower severity fire impacts but possible additional die off from insect damage. In a similar manner, it is important to note that future wildfires and even climate change may dramatically influence the vegetation conditions in the future, but future impacts of this nature are difficult to estimate. Fuels treatment will be carried out to reduce fuel loading to acceptable levels. Fuels treatments will cover forestland that will require future assessment for reforestation needs. Future reforestation in the fuel treatment area will follow the reforestation prescription as established herein.

Because little research exists on knobcone management, adaptive management process will be critical in this project to address the management of Knobcone pine.

5.3 Spatial and Temporal Context for Effects Analysis

The entire project area was used as the analysis area for the vegetation resource direct, indirect, and cumulative effects. Measurement indicators will serve to guide the analysis. Vegetation treatment effects will be analyzed at the treatment prescription level. Second, the cumulative effects analysis will include discussion on events relative to vegetation management that occurred on all National Forest System (NFS) lands within Project area. The temporal scale of this analysis ranges from short to long term. The duration of the short-term effects is up to about 10 years from the implantation of the treatments. Long-term effects are those effects that exceed 10 years from implementation and may extend to at least 30 years.

5.4 Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis

For cumulative effects on Vegetative resource in the project area, past, current, and reasonably foreseeable future events include past forest management and past wildfires, the 2018 Ranch Fire, the Bartlett roadside hazard tree removal project, and other future forest management activities. These actions would add cumulatively to the potential direct and indirect effects of the action alternatives.

The Council on Environmental Quality's (CEQ) regulations for implementing the National Environmental Policy Act (NEPA) define cumulative effects as the environmental impact that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such other actions (40 CFR 1508.7).

The past, present and reasonably foreseeable activities that are relevant to the vegetative resource are activities within the affected environment including recent wildfire activity, current and past vegetation management actions and past wildfire activity. Direct and indirect effects consider treatments associated with the action and no action alternatives. Cumulative effects are those of past, current, and future foreseeable actions where the effects are interactive (i.e., synergistic). Current, past and foreseeable actions are noted in Chapter 1 of the EA.

The entire project area was used as the analysis area for the vegetation resource direct, indirect, and cumulative effects. Measurement indicators will serve to guide the analysis. Vegetation treatment effects will be analyzed at the treatment prescription level. Second, the cumulative effects analysis will include discussion on events relative to vegetation management that occurred on all National Forest System (NFS) lands within Project area including major wildfire events. The temporal scale of this analysis ranges from short to long term. The duration of the short-term effects is up to about 10 years from the implantation of the project treatments. Long-term effects are those effects that exceed 10 years from implementation and may extend to at least 30 years. Past vegetative treatments are typically viewed as treatments that have occurred in the ten years previous to the proposed activity. Wildfire activity will take into account the Fork fire that occurred 1996 which burned at varying intensities greater than 50% of the project area. The vegetative condition that developed post Fork fire substantially effected the fire severity associated with the Ranch fire.

6.0 Alternative 1 – No Action

Intent: Alternative 1 provides a baseline for comparison of environmental consequences of the other alternatives to the existing condition (40 CFR 1502.14) and is a management option that could be selected by the Responsible Official.

7.0 Alternative 2 – Proposed Action

7.1 Project Design Criteria and Mitigation Measures

Salvage timber harvest of fire killed and injured (dying) trees will comply with the following prescriptions.

Matrix Salvage Units (RX 7 -Timber Modified)

Follow the Marking Guidelines for Fire-Injured Trees in California (Smith et al. 2011) and remove all merchantable fire killed trees (14” DBH or greater with a 0.7 or higher probability of mortality. Marking Guidelines for Fire-Injured Trees in California provide a method for determining the probability of fire injured tree to succumb to fire impacts. The probability of mortality rating is a number between 0 and 1, where, roughly speaking, 0 indicates impossibility and 1 indicates certainty expressed as a numerical description of how likely a tree is to die. The higher the probability, the more likely the tree will die. To determine species specific percent crown length killed for pines refer to Table 1 or Tables 2a and 2b when evaluating trees post-bud break for yellow pine. For sugar pine refer to tables 5, 6a or 6b. To determine percent crown volume killed for Douglas-fir refer to Table 9. For additional information refer to The Marking Guidelines for Fire-Injured Trees in California (Smith et al. 2011). (Note: The following tables have been copied from the Marking Guidelines for Fire-Injured Trees in California (Smith et al. 2011) Table numbers refer to the table number from these Marking Guidelines).

Refer to Post Treatment Snag Retention guidelines described below.

Refer to Post Treatment Coarse Woody Debris guidelines described below.

Avoid extended skids (100 feet or more) across slopes steeper than 35 percent.

Ground and Cable based timber harvesting systems are proposed for areas that have existing harvest systems in place.

100 Acre LSR Salvage Units (RX 6 -Late-Successional Reserves)

Follow the Marking Guidelines for Fire-Injured Trees in California (Smith et al. 2011) and remove all merchantable fire killed trees (14” DBH or greater with a 0.9 or higher probability of mortality. Retaining standing live trees except for trees with a 0.9 probability of mortality will address the LRMP objective of including those injured that are likely to survive. Surviving trees provide a significant residual of larger trees in the developing stand. Defects caused by fire in residual trees may accelerate development of structural characteristics suitable for associated late successional species. Those damaged trees may eventually die, and will provide additional snags.

Refer to Post Treatment Snag Retention guidelines described below.

Refer to Post Treatment Coarse Woody Debris guidelines described below.

<u>Protect existing hardwood stump sprouts where possible.</u>

Prohibit extended skids (100 feet or more) across slopes steeper than 35 percent.

Cable based timber harvesting systems from existing roads may be used.

Riparian Reserves (RX 4 -Minimal Management)

Follow the Marking Guidelines for Fire-Injured Trees in California (Smith et al. 2011) and remove all merchantable trees with a 0.9 or higher probability of mortality.

Refer to Post Treatment Snag Retention guidelines described below.

Refer to Post Treatment Coarse Woody Debris guidelines described below.

Directional felling will be used to protect streambanks.

Maintain CWD in concentrations that do not create an unacceptable fire hazard.

Timber harvesting in Riparian Reserves would occur under Alternative 2. SMZ’s will be established as equipment exclusion zones.

Fuels treatment Trees less than 14 inches.

Salvage units fuel reduction action shall be applied to fire killed or injured trees 14 inches in diameter or less. Treatment will be applied to trees that depending on market conditions may have value as biomass products, but do not have a commercial value as lumber products. Application may occur as a combination of prescribed burning, hand or mechanical harvesting, hand or mechanical piling, chipping, pile burning, or biomass removal. To reduce activity fuels, other surface fuels, and maintain them in the desired condition, prescribed fire may follow treatment.

Post Treatment Snag Densities:

Retain fire killed conifer trees for snag retention at a rate of four of the largest snags per acre averaged over 40 acres of matrix area. Trees retained for snags maybe either Douglas-fir, ponderosa, or sugar pine where possible two of the four trees retained for snags should be Douglas-fir as Douglas-fir generally has a longer retention time frame. Cluster snag trees where such natural clumps of the largest trees in the stands occur, and scatter others where stands are more uniform in size. Retained snags maybe hard (recently killed) and soft (older, rotten, structurally weakened) snags where they are not a current or potential future safety or fuel hazard.

Where snag densities exceed the metrics in the fuels report follow the fuels prescription.

Use variable spacing if possible in distributing snags to mimic natural stands. Snag spacing can be applied with flexibility to ensure that the most highly desired snags are retained. To maintain diversity and to avoid single tree species retention, the species type retained would be in the same proportion as the species that occur naturally in the project area.

Retain any tree with nests or stick platforms.

Retain all pre-fire existing un-merchantable snags unless they pose a threat to human safety or occur in densities that could result in high fuels levels. Refer to the Fire and Fuels Report for more information.

Retain all hardwood snags, particularly black oak snags over 12” DBH if they do not pose a safety or fuels hazard.

Post treatment Coarse Woody Debris (CWD)

Maintain CWD in concentrations that do not create an unacceptable fire hazard.

Maintain a minimum of 5 to 20 tons per acre of course woody debris comprised of a minimum of four recently-downed logs per acre, averaged over 40 acres of matrix area. When present focus retention on logs equal to or greater than 20 inches in diameter (large end), or the largest diameter logs available. Retained logs should range from 15 to 20 feet in length, with one log per acre greater than 20 feet in length. Where course woody debris CWD is deficit, defer Yarding of Unutilized Material (YUM) within the unit until required numbers and size classes are met.

Retain coarse woody debris already on the ground and protect where feasible from disturbance during treatment (e.g. slash burning and yarding) and site preparation/Planting.

Maintain all existing large logs unless they contribute to hazardous fuels levels

Where feasible Retain coarse woody debris already on the ground and protect from disturbance during treatment (e.g. slash burning and yarding) and site preparation/planting.

All coarse woody debris (CWD), greater than 20 inches in diameter at the large end and 10 or more feet in length (preferably over 20 feet), would be protected during harvest operation, fuels treatments and site preparation. If the amount of larger coarse woody debris (greater than 20 inches in diameter at the large end) is abundant enough to cause a hazardous fuels condition, a portion of these logs may be treated/removed. Remove the smallest logs first until fuels objectives are met. Retain the maximum number possible while still meeting fuels objectives.

Refer to Table 9 RAVG Burn Severity Salvage Area. Future fuel reduction treatment activities may be applied to these non-commercially treated acres. Refer to the Fire and Fuel prescription and the North Shore Restoration Project Fuels Report.

Table 9: RAVG Burn Severity Salvage Area

Salvage Area Burn Severity Classes	Acres	Total Percent Basal Area Loss
No Loss 0%	0	0%
Low 0-24%	38	6%
Mixed 25-49%	105	18%
High 50-74%	79	13%
Very High 75-100%	369	62%
Grand Total	592	

The following tables have been copied from the Marking Guidelines for Fire-Injured Trees in California (Smith et al. 2011) Table numbers refer to the table number from these Marking Guidelines

Table 1. YELLOW PINE: percent crown length killed (PCLK) and DBH *(use post-bud break)**

- Use Table 1 when only assessing crown injury.

Probability of mortality (Pm)	.10	.20	.30	.40	.50	.60	.70	.80	.90
DBH	Percent crown length killed (PCLK)								
10 - <30”	25	35	40	45	50	55	60	65	70
30 - 40”	--	5	10	15	25	30	40	45	60
>40 - 50”	--	--	--	5	10	15	25	30	45

Table 2a. YELLOW PINE: PCLK, DBH and red turpentine beetle pitch tubes PRESENT*

- Use Tables 2a and 2b when assessing crown injury and red turpentine beetle presence/absence
  Note: Use of this guideline is appropriate when significant red turpentine beetle activity is detected. FHP personnel can assist with this determination.

Probability of mortality (Pm)	.10	.20	.30	.40	.50	.60	.70	.80	.90
DBH	Percent crown length killed (PCLK)								
10 - <30”	10	30	35	40	45	50	55	60	65
30 - 40”	--	--	--	--	--	5	10	15	25
>40 - 50”	--	--	--	--	--	--	--	5	10

YELLOW PINE

Table 1 or Tables 2a and 2b are to be used when evaluating trees ***post-bud break***.

YELLOW PINE (continued)

Table 2b. YELLOW PINE: PCLK, DBH and red turpentine beetle pitch tubes ABSENT*

Probability of mortality (Pm)	.10	.20	.30	.40	.50	.60	.70	.80	.90
DBH	**Percent crown length killed (PCLK)**								
10 - <30”	30	35	50	55	60	65	70	75	80
30 - 40”	5	10	20	25	30	40	45	55	65
>40 - 50”	--	--	--	5	10	15	25	35	45

* When the cambium kill rating (CKR) is determined for **yellow pine,** *post-bud break*, use the following percent crown length killed adjustments for Tables 1, 2a and 2b: For yellow pine **10 - <30” dbh**, *add* 5 percentage points when CKR = 0 or 1, *no change* when CKR = 2, and *subtract* 10 percentage points when CKR = 3 or 4. For yellow pine **>30” dbh**, *add* 5 percentage points when CKR = 0 or 1, *no change* when CKR = 2, and *subtract* 5 percentage points when CKR = 3 or 4.

SUGAR PINE

Table 5: SUGAR PINE - percent crown length killed (PCLK)*

- Use Table 1 when only assessing crown injury.

Probability of mortality (Pm)	.10	.20	.30	.40	.50	.60	.70	.80	.90
DBH	**Percent crown length killed (PCLK)**								
10 – 60”	--	30	40	50	50	55	60	65	70

Table 6a: SUGAR PINE - PCLK and red turpentine beetle pitch tubes PRESENT*

- Use Tables 6a and 6b when assessing crown injury and red turpentine beetle presence/absence
  Note: Use of this guideline is appropriate when significant red turpentine beetle activity is noted. FHP personnel can assist with this determination.

Probability of mortality (Pm)	.10	.20	.30	.40	.50	.60	.70	.80	.90
DBH	**Percent crown length killed (PCLK)**								
10 – 60”	--	--	--	30	40	45	55	60	65

Table 6b: SUGAR PINE - PCLK and red turpentine beetle pitch tubes ABSENT*

Probability of mortality (Pm)	.10	.20	.30	.40	.50	.60	.70	.80	.90
DBH	**Percent crown length killed (PCLK)**								
10 – 60”	30	45	55	60	60	65	70	75	80

* When the cambium kill rating (CKR) is determined for **sugar pine**, use the following percent crown kill adjustments for Tables 5, 6a and 6b: *Add* 5 percentage points when CKR = 0 - 3 and *subtract* 20 percentage points when CKR = 4.

DOUGLAS-FIR (Hood 2008)

Table 9. DOUGLAS-FIR: percent crown volume killed (PCVK), and DBH *

- This guideline uses ***percent crown volume killed*** (not percent crown length killed). Visually estimate the volumetric proportion of crown killed compared to the space occupied by the pre-fire crown volume to the nearest five percent (Ryan 1982).

Probability of mortality (Pm)	**.10**	**.20**	**.30**	**.40**	**.50**	**.60**	**.70**	**.80**	**.90**
DBH	**Percent crown length killed (PCLK)**								
4 – 40”	--	10	25	55	65	70	75	80	90

* When the cambium kill rating (CKR) is determined for **Douglas-fir**, use the following percent crown kill adjustments for Table 9: *Add* 5 percentage points when CKR = 0, *no change* when CKR = 1, *subtract* 5 percentage points when CKR = 2, *subtract* 10 percentage points when CKR = 3, *subtract* 20 percentage points when CKR = 4.

7.2 Salvage Operations Snag Retention

Marking guidelines for fire-injured trees have been developed following guidance from Table 10 Snag retention guidelines from the Mendocino Land and Resource Management Plan 1995 for Montane Conifer. The marking guidelines require that the largest snags per acre (4 snags Rx7, 4 snags Rx6 and 4 snags Rx4) averaged over forty acres be retained. This could result in some units having a cluster of the largest snags in pockets.

Table 10: Snag retention guidelines from the Mendocino Land and Resource Management Plan 1995 for Montane Conifer

TYPE: Montane Conifer 1/			
HABITAT VARIABLE	**HIGH** (Optimum)	**MODERATE** (Sub-optimum)	**LOW** (Marginal)
Average density			
…15-24” DBH	>3.0/acre	1.2-3.0/acre	<1.2/acre
…>24” DBH	>0.5/acre	0.2-0.5/acre	<0.2/acre
…Total	>3.5/acre	1.43.5/acre	<1.4/acre
	(max = 10/acre)	(max = 5/acre)	(max = 3/acre)
Height	>40 feet	20-40 feet	<20 feet
Dispersion	One group per 5 acres or less, with 15+ snags	One group per 5-15 acres, with 5-15 snags	Even dispersion
Hard:Soft Ratio	>3:1	2:1-3:1	<2:1
Location	Edges of meadows, brush fields, streams, and other water	Throughout wooded stands	Rocky, open slope, Barren areas

Species	Douglas fir, Ponderosa pine, Sugar pine, Knobcone, Black oak, Blue oak, Madrone	Douglas fir, Ponderosa pine, Black oak	Douglas Fir, Black oak

1/Includes ponderosa pine, mixed conifer, Knobcone pine, coast range montane, mixed evergreen, and black oak

7.3 Forested Burned Areas not treated by Salvage Operations

Salvage operations are being applied to an estimated 592 acre area. Outside salvage treatment units there is substantial area of forest cover located within the burned area which burned at various levels of severity. Total conifer vegetation type consists of 4334 acres. Salvage treatment is being applied to 14 percent of the conifer acreage within the project area. The 3742 acre area where commercial salvage operations will not take place will be subject to treatment as part of the Fire and Fuels prescription.

The extent of proposed salvage treatment is driven by slope constraints and a desire to avoid new road construction. To expand the treatment area to slopes greater than 35 percent would require cable or helicopter logging. Cable logging would require some new temporary road construction; whereas, helicopter logging would eliminate the need to construct new roads, but these logging systems were considered not economically feasible under current market conditions. Untreated burned areas will still have various levels of present and future fuel concentrations. Reduction in fuel loading in these areas will be provided through a combination of thinning (both mechanical and hand) and prescribed fire aimed to reduce fuels over time. Refer to the Fire and Fuels treatment prescription.

7.4 Site preparation

Treatments will be completed with the objective of preparing sites for reforestation. Treatment includes reducing hazardous fuels to levels described in the Fuels report, and reducing competition to the newly planted or naturally regenerated seedlings. Prior to planting site preparation needs will be evaluated based on exiting site conditions immediately before planting. Site preparation may be completed with both mechanized or hand treatments. One objective of site preparation is to leave enough material on the sites to provide microsites favorable for seedling survival. This includes down woody debris, standing snags, high stumps, and other features which create shade or help to reduce surface temperatures and increase the water holding capacity of the site. All treatments will comply with BMP’s and other design features described in the Hydrology report as well as Appendix B of the Environmental Analysis. All site preparation treatments will avoid damaging any existing green trees that survived the wildfire.

7.5 Reforestation

Reforestation is an essential part of post-fire restoration. Reforestation efforts shall first begin in Areas where reforestation activates have previously occurred. Within the North Shore Restoration project area, both planting and natural regeneration will contribute to establishing forest cover ideal for watershed stabilization, wildlife habitat cover and forage, seed source establishment, regaining timber production, and aid in reaching desired future condition in recognition of potential climate change.

Reforestation of the sites will include planting seedlings grown from seed collected from Mendocino national Forest within California seed zone 372. This seed zone occurs primarily in the southern third of forest, Refer to Forest Seedling Network, 2013. Seed was either directly collected from the Mendocino National Forest, or collected from trees grown from grafted material on trees at the Chico seed orchard.

Reforestation shall take place on approximately 1617 acres of conifer forestland where plantations were established in the past. These plantations burned at various levels of burn severity with 74 percent of the acreage burning at very high severity. Refer to Table 11 for burn severity values of reforestation units.

Table 11: RAVG Burn Severity Reforestation Units

Reforestation Area Burn Severity Classes	Acres	Total Percent Basal Area Loss
No Loss 0%	1	0%
Low 0-24%	50	3%
Mixed 25-49%	156	10%
High 50-74%	215	13%
Very High 75-100%	1195	74%
Grand Total	1617	

In addition to the area covered by previous plantations, reforestation activities will be applied to areas covered by the Bartlett Hazard Tree Abatement CE (485 acres) and the NSRP areas proposed for salvage logging (592 acres). These areas have been identified as a priority to reforest in order to develop future conifer or conifer hardwood forests. In addition, reforestation may take place in other areas where conifer or hardwood tree removal will be accomplished by fuel reduction treatments. These area will be assessed following fuels treatment for regeneration needs.

Reforestation shall be accomplished by low density planting with variable arrangement and species mix.

To achieve desired future conditions, planting density will be at a level that provides for some mortality initially and over time. The seedlings will require monitoring to ensure adequate survival. If seedling densities of both natural and planted seedlings do not meet desired stocking level, sites should then be examined for additional planting needs. The examination should focus on any adjustments necessary to be made to correct problems which may have led to the failure of the first planting.

Areas of low to moderate burn intensity have a higher probability for natural regeneration to be present. These areas are generally associated with the fuels treatment portion of the restoration project. They will be surveyed and evaluated for density and species composition after treatment and prior to any planting action.

All planted seedlings will have scalps dug at the time of planting and holes will be dug using either power augers or hand tools. Other standard planting, release, and thinning practices will apply.

Trees will be planted using one of three methods: Individual tree planting 14 feet x 14 feet spacing, clustered tree planting, or a combination of the two methods. Areas where a 14 foot spacing is applied will have planting locations scalped, holes augured or hand dug (Refer to Figure14). A total of 222 tree per acre will be planted using this method. When applying the cluster planting configuration as shown in Figure 15, a total of 210 trees per acre will be planted and arranged as seventy clusters of three trees distributed across each planting acre. Plot centers will have an average spacing of 25 feet between planting clusters center points. Individual tree locations should randomly vary within the 10 foot radius planting circle avoiding any semblance of a straight line to create spatial heterogeneity. Planted trees shall have 10 foot minimum spacing distance along the planting circle. If natural regeneration, defined as any conifer species that dominated the forest (Douglas-fir, ponderosa pine, or, sugar pine) or black oak stump sprout or seedling, are on the site they will be incorporated into the clusters or individual tree design. In areas where a combination of the two planting designs is determined appropriate by the silviculturist, these area will have a minimum planting density of 200 trees per acre. Example where the combination method may be applied is along the first 100 feet from a roadside where cluster planting would occur then after that distance revert to 14 foot spacing.

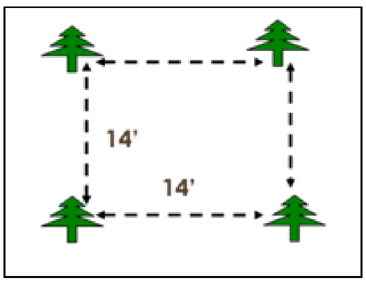


Figure 14 Individual Tree Spacing

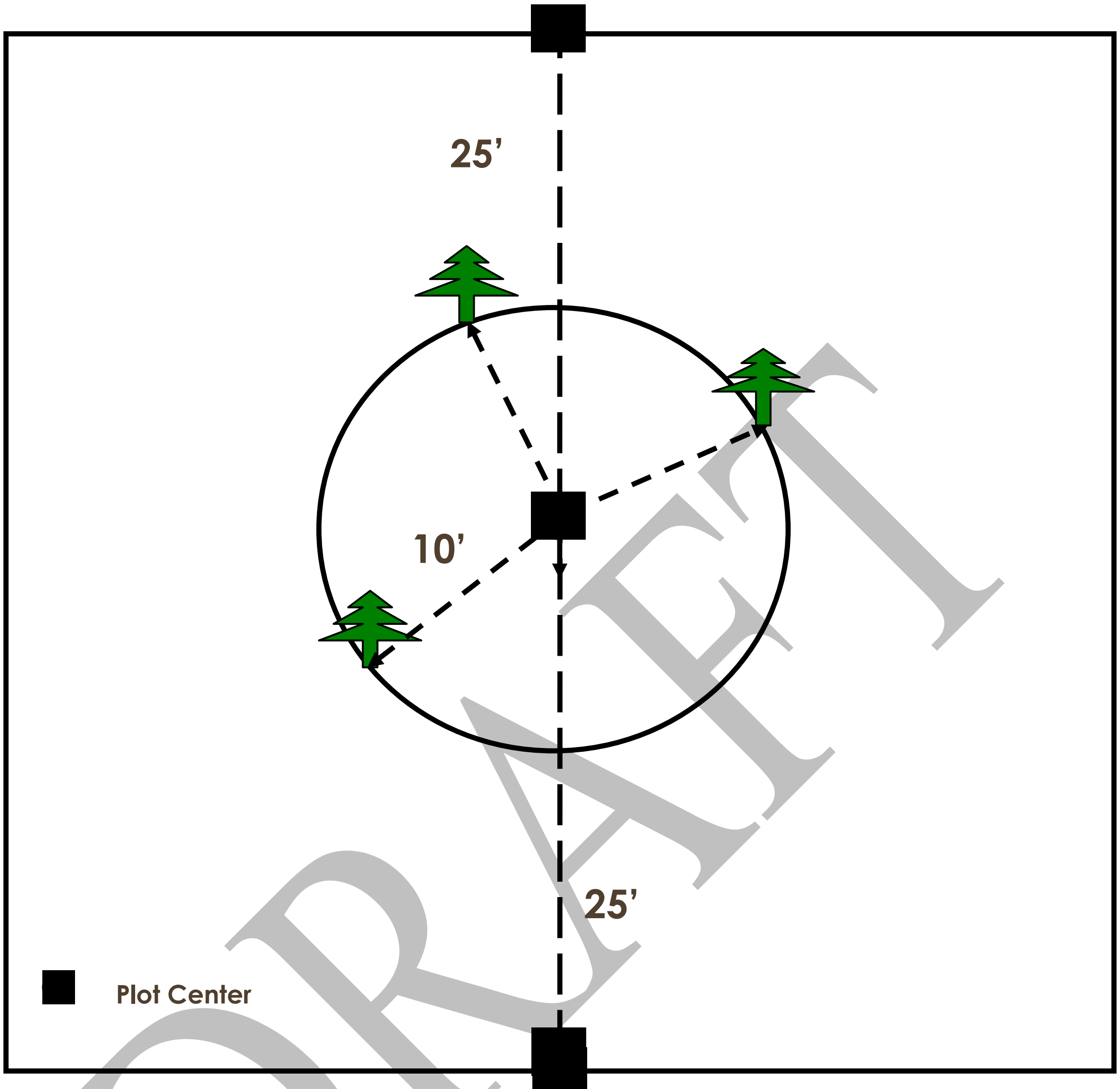


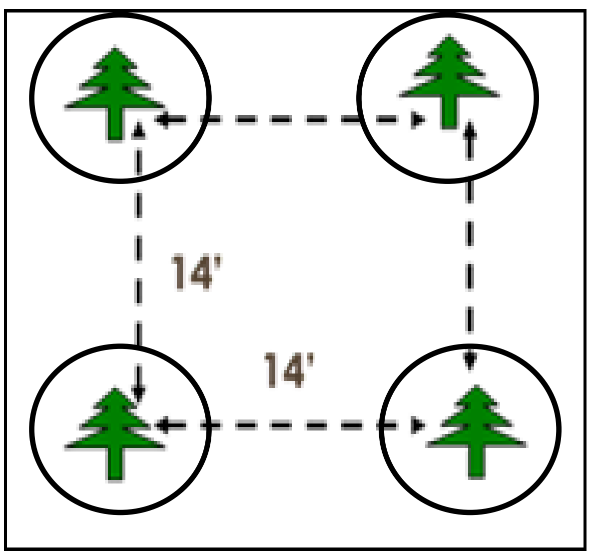
Figure 15: Cluster Planting Diagram

7.6 Release for Survival

After successful reforestation seedlings and natural regeneration may need to be released from competition where necessary to promote survival and growth of seedlings. This will be determined through on site monitoring efforts.
Within the first 1-3 years planted areas will be monitored to determine the need for competing vegetation control. Potential treatment will involve, hand or mechanical grubbing of grasses and other competing vegetation away from the trees in a 5 foot radius circle. (Refer to Figure 4)

As a substitute to hand or mechanical grubbing, herbicide treatment is proposed to control shrub species. This treatment will also be applied to a 5 foot radial treatment around seedlings to kill competing shrub vegetation. (Refer to Figure 4) Herbicide treatment will be applied for survival for the first 1-3 year period, and targets only shrubs to allow for maintenance of a reduced shrub cover within the planted area. Initial herbicide treatment is expected to be adequate for most sites.

After the first 3 year period, the planted areas will be inspected for the need of additional herbicide treatment. Should shrub densities require treatment herbicides may be applied to impede growth or reduce shrub cover within planted areas for the next ten to fifteen years on an as needed basis. These treatments will be limited to a 5 foot radial treatment around trees to kill competing shrub vegetation. The 10 foot diameter treatment zone around each tree planted at a 14 foot spacing represents on a per acre basis applying herbicides to approximately 40 percent leaving 60 percent of the acre not treated with herbicides. The ten foot diameter treatment zone around each cluster planted tree represents on a per acre basis applying herbicides to approximately



38 percent leaving 62 percent of the acre not treated with herbicides.

Figure 16: 10 foot diameter Treatment Area for each Tree

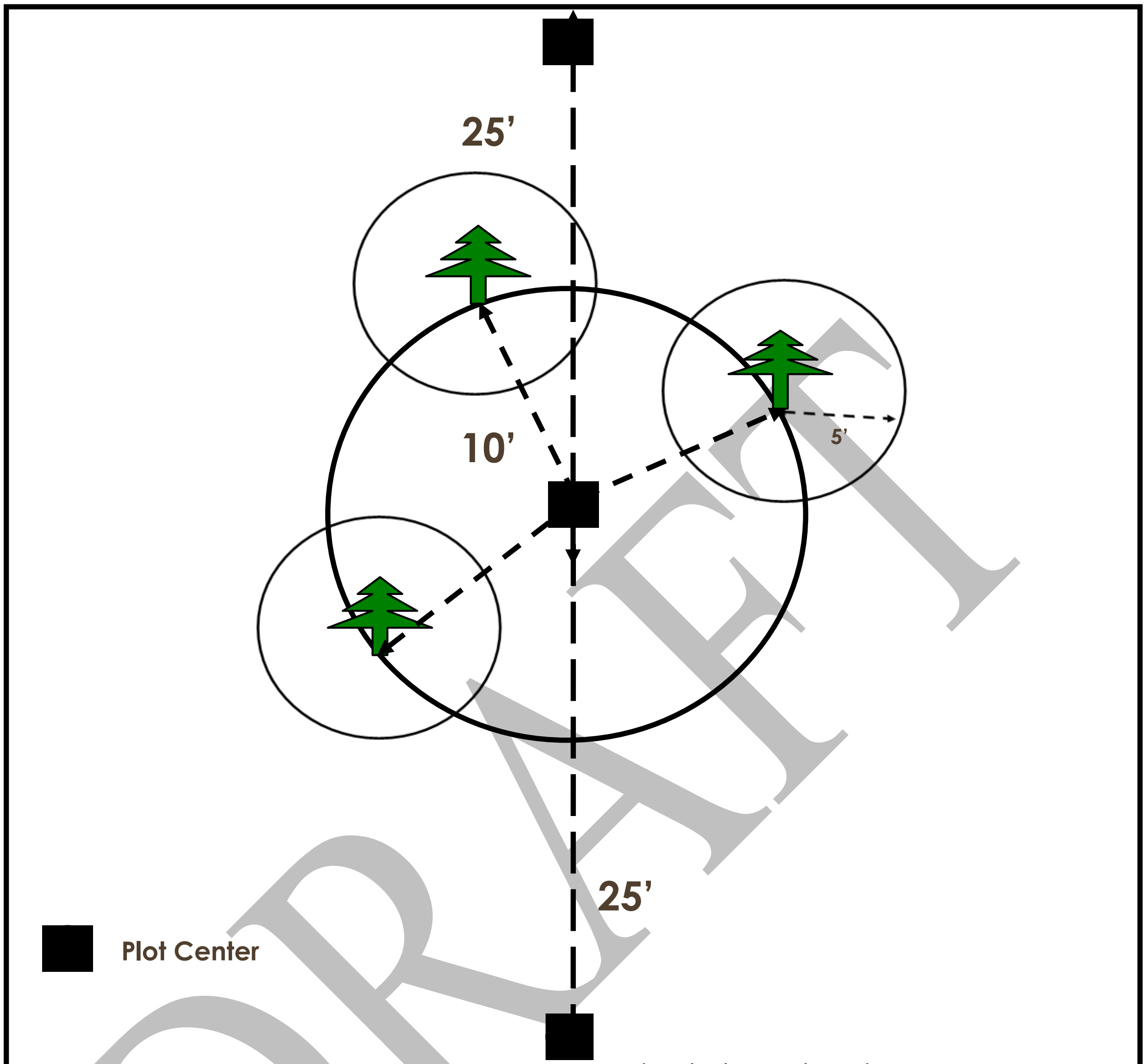


Figure 17: Ten Foot Diameter Treatment Area around Each Cluster Planted Tree.

7.7 Pre-Commercial Thinning

When canopy closure begins to impede tree growth, that is when crowns of the regeneration begin to touch, they will be evaluated for pre-commercial thinning. Thinning will space trees out and reduce fuel hazards within the stands. This will also increase individual tree growth and vigor, facilitating the stands to more quickly develop towards older forest characteristics (Franklin et al., 2007). Preference for conifer “leave trees include healthy sugar pine, Douglas-fir and ponderosa pine. In addition to these conifers, a target of twenty to thirty black oak stems per acre, where available, will provide for a more diverse and heterogynous stand. A diversity of species, sizes, and spacing should be maintained where possible to move stands more quickly to a forest of mature growth characteristics. In the event that conifer species are unable to be regenerated due to climate factor, hardwood may be left in higher numbers.

7.8 Standards for Pre-Commercial Thinning

Diameter Limit: Planting densities have been designed to develop today the forest of tomorrow. This premise should limit the need for extensive pre-commercial thinning. However, should monitoring activities indicate pre-commercial thinning activities are necessary, cutting of trees shall be limited to trees less than or equal to 12 inches DBH, except in cases of safety, where a leaning or damaged tree must be cut to permit treatment of a project area. Target conifer leave trees should generally be the healthiest trees, favoring those species best suited to the site. Trees larger than 12 inches DBH that have commercial value should be removed in a future commercial entry or retained for wildlife habitat. Stem densities should be reduced to around 100 to 150 conifer stems per acre when present. In addition to conifers, a target of twenty to thirty black oak stems per acre, where available, will provide for a more diverse and heterogynous stand.

Leave trees: When necessary to thin trees, leave trees shall be spaced depending on crown position in response to the planting design. The objective of tree spacing shall focus on maintaining crown going space. When overcrowding is occurring space trees an average of between 15 by 15 feet to 25 by 25 feet apart, with the narrower spacing for trees less than 4 inches, and the larger spacing for trees greater than 4 inches DBH. Avoid leaving knobcone pine or gray pines unless no other healthy conifers are available. Cut trees include any tree more than one foot in height and up to 10 inches D.B.H. A diversity of species, sizes, and spacing should be maintained where possible to move stands more quickly to a forest of mature growth characteristics. In the event that conifer species are unable to be regenerated due to climate factor, the leave tree species may be modified to leave hardwood trees in higher numbers.

Species Preference: Leave tree preference is as follows: Healthy sugar pine, Douglas fir and ponderosa pine and black oaks. Leaving healthy trees shall take priority over leaving particular species.

First priority leave trees shall be dominants trees which meet the following five tests:
Crown class – Dominant, with healthy crowns

Bole – Straight and unforked

Health – Shall be vigorous and healthy in appearance.

Growth – Leader length shall be equal to or greater than that on trees of the same size and crown class.

Quality – The limbs shall not be excessively large.

Logging and other damage – Only minor damage is permitted. Bark damage shall not extend more than ¼ of the circumference of the tree. Top of the tree shall not be broken out for more than 1/3 of the length of the crown. No more than 1/3 of the live limbs shall have been removed. Damage includes any defect or deformity of a tree resulting from agents such as wind, snow, animals, insects, disease and equipment, and evidenced by such things as dead or broken tops or branches, crooks, deep scars or irregular growths on the trunk (bole) or branches.

Mistletoe – When dwarf mistletoe infections exist, select trees from the species that are not infected. If all species are infected, select a tree using the following priorities:
1st criteria: No mistletoe is visible.
2nd criteria: No mistletoe is growing on or within one foot of the bole.
3rd criteria: No mistletoe is growing within the top 1/3 of the live crown.

Stump Height. Stump height shall not exceed six inches from the ground on the uphill side or four inches above natural obstacles. All cut trees shall be cut below the lowest live limb, except when prevented by natural obstacles. All live limbs below the cutting point shall be removed. Trees shall be completely severed from the stump.

7.9 Fire and Fuels Prescriptions

Fire and Fuels thinning will focus primarily in the following high value areas identified by the ID team, community input, and through the Scoping process. The high value areas were identified as:

- areas being commercially thinned, and/or re-forested (or other high investment areas),
- wildlife habitat enhancement areas such as protection of legacy trees (dead or alive) and 100 acre LSR's or activity centers,
- legacy green islands,
- WUI areas and fuel breaks,
- areas adjacent or near private boundaries,
- areas where natural regeneration of tree species are occurring and thinning or release of these trees will help promote stand development, and
- Treatment Buffer Zones.

Results of Mendocino National Forest post fire treatment effectiveness monitoring has demonstrated that treatment buffers around high value areas where a feathered thinning treatment (graded density reduction) has been applied helps modify fire behavior before the fire front enters these areas. For this project treatment buffer zones are defined as areas surrounding any high value area where a feathered thinning treatment may be applied. Feathered treatments may also be applied to individual high value habitat elements such as live legacy trees, snags, or wildlife trees to protect it from future fire effects.

Prescribed Burning Prescriptions

F1 - Prescribed Burning: Prescribed burning is proposed across all vegetation types within the Northshore Project area. Prescribed burning includes vegetation treatments such as: pile burning, jackpot burning, understory burning, and broadcast burning. Treatment activities require control lines to be established to aid in holding efforts. Control lines where possible, utilize existing natural or preexisting features such as ridge tops or roads or trails. Control lines are created with the minimum necessary width to hold the prescribed burn within a given boundary. They provide flexibility in controlling how much area is burned at any one time. They are also utilized to curtail activities should conditions become unfavorable.

Control lines are typically hand lines accompanied by a wider area cleared of vegetative material with a chainsaw. Hand lines usually require a 2-3 feet wide scrape down to mineral soil accompanied by a 4-8 feet cutting of vegetation to augment the hand scrape. Mechanical control lines would be limited to a width of ten feet. Mechanical treatment is confined to slopes 35 percent or less. Limited to areas where archeological surveys have been completed and cleared for mechanical work. Mechanical control lines erosion control measure for stabilization will follow hydrological guidelines as set forth in the projects Hydrology Report.

F2 - Fuels thinning outside the Ranch fire burn scar: thinning of trees and shrubs <12" DBH
Tree's shall be thinned to a 15-25 feet spacing. All shrubs shall be removed unless needed to meet spacing requirements in which case manzanita will be the first choice for shrub retention. An individual shrub or clump of shrubs may be left where trees as sparse and not enough exist to keep from having openings greater than 25 feet. Where no trees or manzanita exist (for example Chamise Redshank Chaparral vegetation type), clumps of chaparral 5-10 feet in diameter shall be retained on a 25-50 feet spacing in areas being thinned. Areas to be thinned are areas that are within buffer zones. Some areas of chaparral will be prescribe burned only to provide for a mosaic of chaparral age class diversity for wildlife. (LRMP) Mechanical treatment may be applied on slopes <35% and slopes >35% shall be hand treatment only.

F3 - Fuels thinning within the Ranch fire burn scar: thinning of trees and shrubs less than 21" DBH is proposed across the Northshore Project area. Fire killed trees would be felled and material may be piled, chipped, masticated, lopped, or removed off site. Felling operations would be done mechanically or by hand. (Slopes less than35% would be treated mechanically and/or by hand; slopes greater than 35% shall be treated by hand methods only). Trees less than 21" DBH exhibiting less than 0.7 probability of mortality as determined by the Marking Guidelines for Fire-Injured Trees in California (Smith et al. 2011) shall be left at a 15-30 foot spacing. Trees that have more than a 0.7 probability of mortality will be felled unless retention is necessary for wildlife snag requirements.

Large diameter thinned trees may be left on the ground as course woody debris unless fuel loading is excessive. The minimum course woody debris requirements shall still be met.
Mechanical thinning will be limited to slopes that are 35% or less. Mechanical thinning would be used to chip, masticate, mulch or pile vegetation which would then be either removed as biomass or if that is not possible, burned on site or off-site (i.e. in curtain burners).
Hand-thinning will have no slope restrictions. Hand thinned material would either be chipped or piled for removal (to biomass facilities, burn curtains, decks, etc.) or burned.
Hardwood tree release and enhancement (primarily Oak species): thin oaks to 1-3 stems to encourage oak trees to develop in the shape of a tree rather than an oak in the shape and form of a shrub. Prune trees as needed

F4 - Fuels thinning of non-commercial trees >21" dbh: Trees 21" and above exhibiting any sign of green shall be retained on a 15-30 foot spacing from trees less than 21" DBH; therefore, not following the marking guidelines for fire killed trees.

F5 – Fuelbreaks:
500 feet Shaded fuel breaks. Fuels breaks would be 500" in width following ridgelines and road systems. Remove all dead trees. Retain live trees at 25-35' spacing. Where live trees do not exist, consider planting to create a "shaded fuel break". Mechanical or hand thinning would be used depending on slope. Prescribed burning shall also be utilized. See treatment F1.
Pre-existing strategic. The same fire breaks have been created and re-utilized many times due to their strategic locations during wildfire suppression actions. Because of their strategic use, the same fire breaks would very likely be used in the future. Maintaining these fire breaks would increase the likelihood of success of these firebreaks. Firebreaks are generally previous dozer lines. These fire breaks would be maintained by keeping them clear of vegetation along the dozerlines. Thinning treatment would be applied to a 500width (generally 250' on each side or adjusted as topography or vegetation dictates) from the center of the dozer line. Thinning shall be on the 25-35 feet spacing encouraging the shaded fuel break concept from above where feasible.

Where no trees exist, shrubs may be kept in clumps no greater than 10 feet in diameter and at a 35' spacing to break up fuel continuity.

(Knobcone shall not be left as a leave tree in any circumstances on fuel breaks and fire breaks. Consider planting native grasses and/or forbs to be manage through prescribed burning. This would be used primarily if a continuous low fire hazard fuel bed is desired to be able to use prescribed fire to keep shrubs from taking over fuel breaks)

F6 - Knobcone management: Focus knobcone management in areas that are accessible such as: Fuel breaks,

Along roadsides (particularly those that provide ingress/egress for the public as well as employees and fire personnel),

WUI management areas,

High value protection areas,

Buffer zones where a feathered treatment will be applied, and

Where knobcone needs to be managed to reduce fire intensity entering these areas.

Knobcone prescription: Base on location to high value area. Mechanical thinning and prescribed burning multiple times over a short period of time.

Because little research exists on knobcone management, adaptive management process will be critical in this project. Potentially a second or third rotation of a thin/burn/thin may curtail knobcone expansion into other vegetation types. Perhaps there is a potential to develop stands with reduced density of knobcone and higher density of other tree species. While the intent is to manage this species aggressively in key areas high Value areas, we recognize that knobcone also has a role in the natural ecosystem. There are thousands of acres of closed cone cypress vegetation type that will be managed through following the minimal management treatments such as limited to prescribe burning on a more historical fire regime only.

Multiple entries of thinning and burning treatment would likely be necessary in close intervals to discourage cone production and limit fire induced seed germination. To promote root burl survival of hardwood species prescribed fire will be applied at cooler temperatures.

To help develop a stand that is not dominated by knobcone where soil conditions are favorable plant trees that would eventually shade out knobcone trees.

To discourage knobcone form expanding into shurbland habitat develop and maintain a shrubland prescribed fire program. Refer to Fire and Fuels Report.

8.0 Alternative 3- Proposed action with limited use of herbicides

This alternative follows the actions of Alternative 2 with limited herbicide use. Under this alternative, herbicide use for release treatments will be limited to research plots. Use of herbicides to control invasive plants will remain the same as Alternative 2. Refer to sections 11.0 and 12.0 for effects analysis, comparison of Alternatives and the Botanical Report for information on invasive plants.

9.0 Alternative 4- Proposed action with no herbicide use

This alternative follows the actions of Alternative 2 without the use of herbicides. Refer to sections 11.0 and 12.0 for effects analysis and comparison of Alternatives.

10.0 Alternative 5- Proposed action to include Diameter limit for removal of fire killed or injured trees.

This alternative follows the actions of Alternative 2, but includes the retention of all standing snags and Coarse Woody Debris greater than 21" DBH. . Refer to sections 11.0 and 12.0 for effects analysis and comparison of Alternatives.

11.0 Direct and Indirect Effects

Direct effects are defined here as those that are triggered immediately as a result of implementation of the North Shore Restoration project activities. Direct effects take place in the near-term. Direct effects include operation revolving around the removal of fire killed trees, snag density reduction, reduced fuel loads, and tree planting activities.

Indirect effects are those that would occur within the treatment stands over a more extended, longer-term time scale. Indirect effects would include long-term, occupation of the site with shrub species, altered stand structure and development, and altered distribution of dead vegetation (fuels). The duration of these indirect effects would be several decades. The time frames for indirect effects correspond to the time required for the planted and naturally regenerated seedlings to occupy the site. Time for residual fire killed trees to decay and fall as coarse woody debris.

11.1 Direct and Indirect Effects Alternative 1 (No Action)

By definition, direct and indirect effects (40 CFR 1508.8), and cumulative effects (40 CFR 1508.7) result from the proposed action, and thus are not germane to the no action alternative.

If no action is taken in the project area as discussed above none of the project objectives will be met. Tens of thousands of fire killed trees will be left. Hazardous fuel levels will exceed those levels described in the LRMP (Refer to the Fuels Report), and early seral species, competing vegetation, and lack of seed sources and seedlings will adversely impact the rate of development of the forest of the future. Also with the full realization that the economic value is not in the forest products removed, but in the restoration work accomplished, the no action alternative will not contribute to the restoration of the North Shore Restoration Project area to a forestland meeting multiple objectives and providing a suite of ecosystem services.

Under Alternative 1, no fuel treatments would be implemented to accomplish the purpose and need. The no-action alternative does not propose active resource management. The intent and the desired condition set forth the LRMP and NWFP would not be achieved, however this does not mean that ecosystems would not change, even in the absence of active management. Fuel loading will progress as shown in Table 13 and 14 of the proposed action.

11.2 Direct Effects Alternative 2 (Proposed Action)

Fire Killed or Injured Tree Removal:

The beneficial effects by taking action to reduced fire killed trees, fuel loads, competing vegetation will last for many decades. Not addressing the fire killed trees in this area could impede recreation as well as pose direct safety risks to the public who recreate, or occupy adjacent property and Forest Service personnel who work in this high use areas.

The removal of fire killed trees will assist reforestation operations by eliminating fire kill trees from becoming hazard that would prevent planting operations. Planting with a mix of species will assist forest restoration to develop a varied species composition forest. The severity of the wildfire left a substantial portion of the project area without a seed source for natural reforestation.

Given the recent disturbance history of this area (See Fuels Report) it is likely that disturbances, natural or human caused will take place before successional pathways to diverse seral conditions are again reached. The restoration plan recognizes this potential and therefore has planned to implement a variety of treatments to combat fuel loading in multiple ways.

Refer to Table 12: Direct Effects on Vegetation and Mitigation of Adverse Effects Occurring in the Near-Term.

Refer to Table 13: Comparing the Proposed Action and No Action alternative current and future fuel loading in tons/acre.

Table 14: Comparing the Proposed Action and No Action alternative current and future fuel loading by percent reduced.

Table 12: Direct Effects on Vegetation and Mitigation of Adverse Effects Occurring in the Near-Term.

Treatment	Vegetation Effects	Beneficial and / or Adverse	Mitigation of Adverse Effects
Salvage Harvesting	Lower Fuel Loads.	Beneficial /Adverse[1]	Snag and CWD retention guidelines, Fire marking guidelines, no equipment in stream management zones (SMZ).
	Establishes standards for Coarse woody debris (CWD) and snag recruitment		
	Reduce potential fuel loading from fire killed trees		
	Reduced health risk to residual trees		
	Fewer Snags		
	Reduced Hazard Trees		
Site Preparation	Fuel reduction /competition control	Beneficial /Adverse[2]	Avoid areas with natural regeneration, follow compaction mitigation measures in Hydrology Report
Reforestation	Establishes seedling in areas which lack a conifer or hardwood seed source. Accelerated growth of planted seedlings or natural regeneration of major forest species	Beneficial /Adverse[3]	Release and Thinning Treatments

Table 13 and 14 were developed from data collected as part of the research project lead by Morris Johnson of the Pacific Northwest Experiment station. The Forest Vegetation Simulator (FVS) and the Fire and Fuels Extension (FFE) of FVS were used to simulate post-fire conditions for the potential buildup of surface fuels over time.

The North Shore Restoration Project proposal would result in 592 acres of salvage harvest operations, all within the designated Wildland-Urban Interface. The duration of that harvest should be completed within 3 years of the fire event. The harvest would produce a spike in fuel loading across the immediate area effected by the harvest, most of which due to broken branch wood in transporting logs to the processing deck. Due to decomposition, the increase in fuel loading versus not logging, reaches an equilibrium duration between seven to ten years. (See Table 13 and 14) Some tops and branches

[1] Fewer snags are both beneficial and adverse. Fewer snags would reduce fuels and allow for reforestation efforts. However it also can reduce site quality, future down wood recruitment, and wildlife habitat.

[2] Site preparation will benefit reforestation efforts by making sites easier for crews to plant as well as controlling competition. Adverse effects include compaction and damage to natural regeneration.

[3] Reforesting sites is beneficial, however can lead to future fuels hazards. This will be mitigated through future release, thinning and prescribe fire activities.

may deliberately be left on site due to needs for duff recruitment, in which case those sites may see a longer duration of increased fuel loading until that material breaks down to duff. After the initial increase, the areas affected by harvest have a net result (sum of all fuel size classes) less fuel loading due to harvest versus not harvesting. Not harvesting continues to build excessive fuel loads for 30 years before starting a gradual decline.

Table 13: Comparing the Proposed Action and No Action alternative current and future fuel loading in tons/acre.

Alternative	Average of all plots taken in Bear Unit Projections of Surface Fuel Loading in Tons/Acre (10 Year Cycles)							
	2019	2029	2039	2049	2059	2069	2079	2089
No Action	12	79	132	137	128	122	110	100
Proposed Action	3	10	15	16	16	15	15	14

Table 14: Comparing the Proposed Action and No Action alternative current and future fuel loading by percent reduced.

Alternative	Average of all plots taken in Bear Unit Percent Surface Fuel Load Reduced (10 Year Cycles)							
	2019	2029	2039	2049	2059	2069	2079	2089
No Action	0%	0%	0%	0%	0%	0%	0%	0%
Proposed Action	27%	88%	88%	88%	88%	88%	87%	86%

Refer to Section 18.0 Appendix B: An Analysis of Fuel Loading and Subsequent Fire Hazard in Post-Fire Salvage Operation Supported By Review of Scientific Information.

Reforestation:

The effect of reforestation with a cluster planting configuration will serve to help develop a random distribution of trees and create spatial heterogeneity. Historically, western mixed-conifer forested landscapes develop a stand structure as a result of natural mixed-severity fire regimes with large individual trees, tree groups of varying sizes, and intervening gaps [Larson & Churchill (2012), Reynolds et al (2013)]. Recent articles (North et al, 2019) conclude that traditional planting in a high density grid like pattern fails to produce both the spatial pattern that recent research has suggested is associated with greater fire and drought resilience, and the diversified structure that is optimal for wildlife habitat and species diversity (Larson and Churchill, 2012). The proposed cluster pattern at low trees per acre density compared to traditional numbers of trees per acre leaves room for openings to develop, and room for occupation by shrubs and other forms of vegetation. Depending on how successful the planted trees survive there is a possibility that the stand will develop with individual trees, tree groups of varying sizes, and intervening gaps.

This stand structure is referred by (North et al) as individual trees (I), clumps (C), and openings (O), or as an acronym ICO. Developing this ICO structure deviates from the traditional approach of full site occupancy by conifer species, but does not alleviate the need for follow up trreatments. When planted trees are more widely spaced, drought stress can be exacerbated by the rapid growth of shrubs and grasses in the high-light environment between trees and increase competition for nutrients and soil moisture, (Lanini and Radosevich, 1986; Riegel et al., 1992; McDonald and Fiddler, 2010; Bohlman et al., 2016). Competing vegetation will require some form of manually, mechanically, or herbicides reduction.

By removing this competing vegetation directly around seedlings there is less competition for water to the seedling and will allow the trees to grow deeper roots than the surrounding herbaceous competition, thereby improving survival rates and growth of the seedlings. Areas treated by herbicide are expected to have lower shrub densities for at least 10 years. This will improve the success and speed of reforestation efforts. Over the short term, plant abundance may be affected by herbicide treatments, but no plant species would be expected to be eliminated from release treatments. Sites with reduced shrubs may have increased plant diversity and species richness compared to stands that are left untreated or only radially released. Battles et al. (2001) found that at the Blodgett Research Station in Georgetown, California, understory species richness was significantly greater in managed plantations than in less intensive treatment types. In mixed forests in Canada, Sutton (1993) found no detectable effect on species composition 10 years after herbicide treatments. DiTomaso et al. (1997) in northern California found no long-term detrimental effect on vegetative cover or species evenness with herbicide use. Trees are expected to grow faster, with the most notable increase evident is in diameter and height growth (McDonald & Fiddler, 2010) in areas treated with herbicide to reduce shrub cover. The effect is a decreasing of time needed to reach a height and structure where seedlings have an increased ability to withstand low intensity fire. Resulting in the effect of increased management options including mechanical treatments and prescribed fire as a management/maintenance tool sooner.

11.3 Indirect Effects Alternative 2 (Proposed Action)

The proposed actions will allow sites to progress towards developing future forestland within the very high severity fire areas, and protect moderate to low severity fire areas given the disturbance history of this area (Refer to Fuels Report). The action is planned to accelerate development of subsequent stands, develop coarse woody debris management, and to bridge to the extent possible maintenance of structural wildlife habitat until future stand development is able to provide natural development of structural habitat.

Salvage harvesting of these stands along with subsequent site preparation and reforestation treatments will allow for establishment of once dominate forest tree species back on these sites as well as facilitate the growth and development of these stands towards forested habitat. The treatments in Matrix areas will capture economic value as well as meet objectives for wildlife and other uses while reestablishing productive timber stands back on these sites. The objective of hazard tree reduction is increased user and employee safety. Safety will be met through a reduction in the number of current and potential future hazard trees either felled or felled and removed from the project area

11.4 Direct Effects Alternative 3 (Limited Herbicides) and Alternative 4(No Herbicide use)

Under these alternatives, herbicide use for release treatments will be limited to research plots or not applied anywhere. The direct effects from these alternatives when applied to the reforestation treatments area are the same. Therefore, the effects analysis is as presented below:

Seedling survival is expected to be significantly less with the limited brush control provided by hand or mechanical release treatment only.

Hand or mechanical release increases cost of release substantially while reducing effectiveness. While grubbing can cost about $250 and is effective if community is mostly grass and forbs or if shrubs are very young (ie. first year) after the 1st year, costs for treatment can go up to as much as $1200 per acre for a single entry depending on brush size. With repeated entries, total costs can result in multiple thousands of dollars per acre for treatments that are labor intensive, time consuming, short-lived and largely ineffective.

Longevity of grubbing treatments is expected to be less than 1 season. Initial hand scraping will need to be done annually to maintain seedlings, while still not providing desirable fuels conditions or stand development.

Without adequate shrub control assisted by herbicides, prescribed fire will be difficult if not impossible to use as a fuel reduction tool.

11.5 Indirect Effects Alternative 3 (Limited Herbicides) and Alternative 4 (No Herbicide use)

Overtime, brush is expected to dominate most areas leaving planted seedlings highly susceptible to loss from wildfire various seedling diseases and limit future management options for use of prescribed fire and mechanical treatments.

Scientific literature shows that with manual released only trees have substantially less diameter and height growth for decades.

Without adequate shrub control assisted by herbicides, prescribed fire will be difficult if not impossible to use as a fuel reduction tool. Lack of herbicide use has the potential hinder the ability to maintain acceptable mortality levels for decades into the future.

11.6 Direct Effects Alternative 5 (Diameter Limit for fire killed or injured trees.

Table 15 and 16 were developed from data collected as part of the research project lead by Morris Johnson of the Pacific Northwest Experiment station. The Forest Vegetation Simulator (FVS) and the Fire and Fuels Extension (FFE) of FVS were used to simulate post-fire conditions for the potential buildup of surface fuels over time.

Table 15: Comparing the Proposed Action and Alternatives 5 current and future fuel loading in tons/acre.

Alternative	Average of all plots taken in LSR Unit Projections of Surface Fuel Loading in Tons/Acre (10 Year Cycles)							
	2019	2029	2039	2049	2059	2069	2079	2089
No Action	14	97	165	179	174	164	150	137
Proposed Action	4	10	15	15	15	15	14	14
Alternative 5	4	55	98	109	112	111	106	99

Table 16: Comparing the Proposed Action and Alternative 5 current and future fuel loading by percent reduced.

Alternative	Average of all plots taken in LSR Unit Percent Surface Fuel Load Reduced (10 Year Cycles)							
	2019	2029	2039	2049	2059	2069	2079	2089
No Action	0%	0%	0%	0%	0%	0%	0%	0%
Proposed Action	27%	90%	91%	91%	91%	91%	91%	90%
Alternative 5	27%	43%	40%	39%	35%	32%	30%	28%

While the immediate direct effects of the initial treatments have identical results, 10 years out the reduction in fuel load is substantially less from Alternative 5, and the fuel load is way out of alinement with CWD tons per acre necessary to maintain wildlife needs (Refer to Wildlife Report). In addition, the standing trees remaining after initial treatment by selecting Alternative 5 is 47% greater than the Proposed Action. This difference will have a direct effect of not reducing the overall hazardous conditions attributed to the higher numbers of fire killed trees remaining. Resulting in unsafe conditions for tree planting as related to worker safety during reforestation efforts.

11.7 Indirect Effects Alternative 5 (Diameter Limit for fire killed or injured trees.

The indirect effects as shown in the tables are the continued high numbers of fuel loading tons per acre caused by selecting Alternative 5 into the future. Without adequate reduction in fuel loading prescribed fire will be difficult if not impossible to use as a fuel reduction tool. (Refer to Fire and Fuels Report.)

Refer to Section 18.0 Appendix B: An Analysis of Fuel Loading and Subsequent Fire Hazard in Post-Fire Salvage Operation Supported By Review of Scientific Information.

12.0 Cumulative Effects

The analysis boundary for the cumulative effects of vegetation of the silvicultural treatments is based on the geography and vegetative cover within the project area.

Project actions will cause slight, localized, short-term increases in fine surface fuel accumulations, especially in areas where cover is needed to protect exposed soils. However, total onsite biomass will be reduced in the short term, thus overall less fuel would be available to burn in a wildfire situation. Additionally, the limited scope of salvage activities would not alter future fire behavior across the landscape. When combined with past, present and foreseeable future activities project activities would not contribute to cumulative effects to future fire behavior and would not increase the risk of severe fire.

The additive effect of past, present, and reasonably foreseeable silvicultural activities have cumulatively lead to some of the existing and future landscape and stand conditions in the NSRP. The Ranch Fire altered most of the surrounding landscape and these altered stand conditions will impact the stands into the foreseeable future.

13.0 Monitoring

Monitor key processes such as mortality, regeneration, growth, fuel accumulation, and new species colonization to inform future management decisions. Monitoring of timber sales per agency policy (i.e., timber sale preparation, timber sale administration, sale activities, utilization, and accountability).Regeneration stocking surveys: all sites with planting or prescribed natural regeneration would be surveyed after the 1st, 3rd, and 5th growing seasons or until certified as adequately stocked.

In addition, the research project set up by Morris Johnson of the PNW will establish a network of permanent monitoring plots to quantify short (< 1 year post harvest) and long (> 20 years) term effects of salvage logging. Salvage logging effects will be quantified and monitored in a randomized-complete block design. For example, three treatment prescriptions will be randomly assigned to treatment units: (1) control (no salvage); (2) intermediate salvage (1/2 to 1/3 basal area removal); and (3) full salvage (100% merchantable basal area removal). Replicated blocks, each containing three 2.2 ha treatment units, were established in high severity (100% tree mortality) planning areas. Within each treatment unit, a grid of 24 nested, permanent fixed-area plots will be established. Plot centers are monumented with a 1.2 m conduit pipe and a steel numbered tag. At plot center, recorded tree species, diameter breast height (DBH), total tree height, and canopy base height of all trees ≥12.7 cm DBH within a 0.04 ha fixed area plot. Trees ≤ 12.7 cm DBH were measured within a 0.02 ha fixed-area plot. Estimate fine (≤ 7.62 cm diameter) and coarse (≥ 7.62 cm diameter) woody fuel loadings ($Mg\ ha^{-1}$) on four 20 m planar intersect transects originating from each plot center (Brown 1974). The endpoints of each transects will be monumented with a 0.60 m conduit pipe. Woody fuel loading will be calculated using standard equations (Brown 1974). Nested within each treatment unit is a split-split treatment of tree planting pattern and vegetation control (optional herbicide application). At the time of re-planting, each treatment unit will be divided into thirds and randomly assigned a planting treatment: (1) unplanted; (2) even spacing at the standard density, and (3) variable density (planting in dense patches, gaps, and wide spacing). Planted seedlings will be mapped in relation to grid points, and height and condition noted during each post-planting visit. Shrub and herbaceous species coverage and natural tree regeneration density will be measured by species. In the unsalvaged and intermediate salvage treatment units, unharvested snags will be tagged and measured (species, DBH, and total height). For each treatment unit, we will use the Fire and Fuel Extension to the Forest Vegetation Simulator (FFE-FVS) to simulate long-term (>30 year) succession of dead woody fuels, potential fire behavior (re-burn effect), and forest development. Plots will be measured before and after salvage logging and we will work with managers on each national forest to coordinate the remeasurement of plots every 5 years.

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15.0 Appendix A: Marking Guidelines for Fire-Injured Trees in California

https://www.firelab.org/sites/default/files/images/downloads/Smith_Cluck_2011_marking_guidelines_fire_injury.pdf

16.0 Appendix B: An Analysis of Fuel Loading and Subsequent Fire Hazard in Post-Fire Salvage Operation Supported By Review of Scientific Information.

The following analysis was developed to assist in understanding fuel loading impacts after a severe wildfire event.

Severe wildfires create pulses of dead trees and can initiate a process of post-disturbance fuel succession that may affect future fire behavior and effects (Agee and Huff, 1987; Passovoy and Fulé, 2006; Kulakowski and Veblen, 2007; Monsanto and Agee, 2008). Surface dead and live fuels change over time as dead trees decompose and deposit needles, branches, tops, and boles on the forest floor; surface fuels decay; and recovering vegetation produces new fuels (Hall et al., 2006; Passovoy and Fulé, 2006). The influence of dead tree pulses and subsequent fuel succession processes on future wildfires depends on the magnitude of the pulse, the time to the next fire, and weather and fuel moisture conditions during the next fire.

Post-fire logging may provide an economical way to expand the scope of restoration-based fuel reduction treatments, reduce the threat of future high-severity wildfires, and improve future forest resiliency to fire in dry coniferous forests (Brown et al., 2003). By harvesting recently fire-killed trees and actively managing the amount and spatial distribution of residual woody debris (standing or fallen), postfire logging may reduce future woody fuel loads, future wildfire intensity and severity, and associated hazards to vegetation, soils, watershed functions, and aquatic ecosystems (DeBano et al., 1998; Brown et al., 2003; Peterson et al., 2009; Johnson et al., 2013). However, post-fire logging is often controversial, with most proponents focused on recovering economic value from fire-killed trees and speeding forest regeneration (Sessions et al., 2004) and opponents focused on protecting burned ecosystems from further disturbance and on retaining standing dead trees (snags) and other woody debris for wildlife use (Beschta et al., 2004; Hutto, 2006).

Past studies of post-fire logging effects on surface woody fuels have produced mixed results, but suggest that time since fire and basal area logged are important factors influencing outcomes. Studies that examined woody fuels shortly after fire and logging (1–4 years) have found that post-fire logging increased surface woody fuels (Donato et al., 2006, 2013; McIver and Ottmar, 2007; Keyser et al., 2009; McGinnis et al., 2010; Monsanto and Agee, 2008), while studies conducted longer after fire (5–35 years) have found that post-fire logging reduced fuels (Monsanto and Agee, 2008; Keyser et al., 2009; Ritchie et al., 2013) or had no effect (McGinnis et al., 2010). Woody fuel loadings in logged stands are also correlated with stand basal area logged (Ritchie et al., 2013), suggesting that differences in stand basal area should be accounted for when studying post-fire logging effects on woody fuels.

Without post-fire logging, surface woody fuels were low in stands surveyed shortly after wildfire, reached maximum levels in stands surveyed 10–20 years after wildfire, and then declined gradually out to 39 years past wildfire. The general pattern of woody fuel loads first increasing and then declining with time since fire was similar among fuel diameter classes. Loadings of large, rotten fuels were very low in stands surveyed during the first 10 years after wildfire, but then increased steadily with increasing time since fire in stands surveyed 10–39 years after fire (Peterson et al., 2015).

With logging, small and medium fuels were highest in stands surveyed shortly after fire (and logging) and declined with increasing time since fire. Large fuels peaked 10–20 years after wildfire, but changed relatively little across the chronosequence of logged stands. As in unlogged stands, rotten, large fuels were very low in stands surveyed during the first 10 years after wildfire, but then increased steadily with increasing time since fire.

Surface woody fuel deposition is particularly rapid during the first decade after wildfire, as fire-killed trees shed branches and a high percentage of ponderosa pine and Douglas-fir snags fall or have tops broken off during this period (Keen, 1929; Dahms, 1949; Everett et al., 1999; Dunn and Bailey, 2012; Ritchie et al., 2013; Peterson, unpublished data). Loadings of small and medium diameter fuels begin to decline, on average, in subsequent decades as most snags have shed branches and tops and decay of surface woody fuels exceeds deposition. Deposition of large diameter fuels can continue to exceed losses to decay for up to three decades, particularly in stands with large diameter snags and more slowly decaying species like Douglas-fir (Dunn and Bailey, 2012).

Post-fire logging altered post-fire fuel succession by: (1) greatly accelerating the deposition of surface woody fuels from logged snags (logging residue); (2) reducing peak loadings of large diameter woody fuels; and, (3) initiating the woody fuel decay stage earlier (at least for small and medium diameter fuels). As a result, post-fire logging produced a transient pulse of elevated surface woody fuel loadings followed by a much longer period of reduced surface woody fuel loadings, relative to burned stands that were not logged (Peterson et al., 2015).

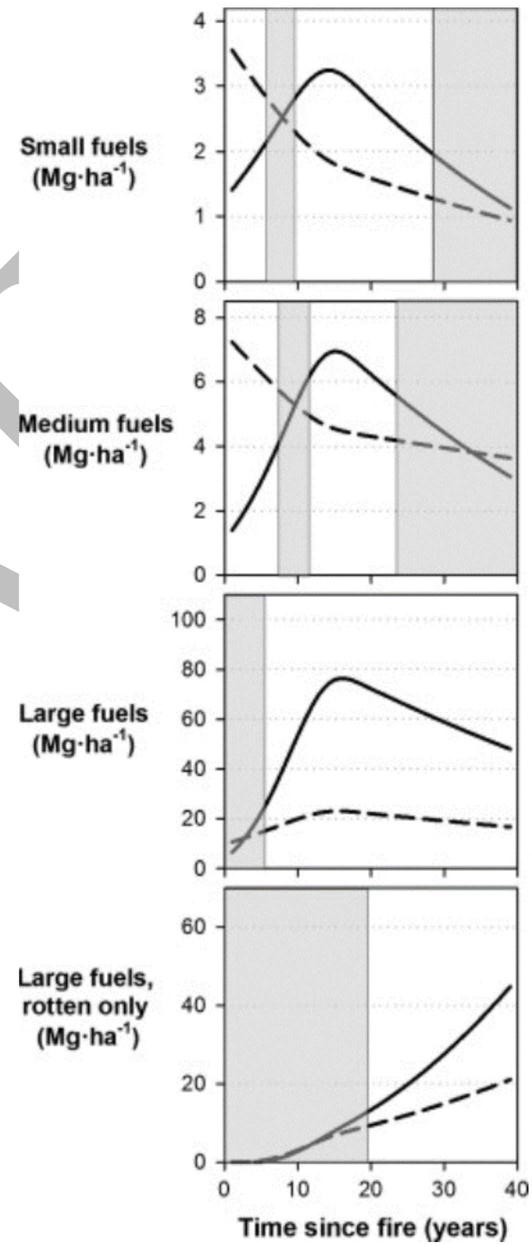
The initial pulse of elevated surface fuels in logged stands was expected under the first hypothesis. Postfire logging transfers woody debris in tree branches and tops from the canopies of fire-killed trees to the forest floor, producing well-documented conditions of higher surface woody fuels in logged stands than in unlogged stands in the first 1–4 years following logging (Donato et al., 2006, 2013; McIver and Ottmar, 2007; Monsanto and Agee, 2008; Keyser et al., 2009). Higher amounts of surface woody fuels –especially small and medium diameter woody fuels – can increase short-term fire hazards in logged stands by increasing potential rate of spread and fire-line intensity (Donato et al., 2006), but actual fire risks are low unless there are enough fine fuels (e.g., litter, grass, and shrub fuels) to carry fire through the logged stand and there are sufficient fuels in surrounding stands to allow wildfires to spread into or away from the logged stand. The period of elevated hazards is also relatively short-lived, as deposition and accumulation of surface fuels from decaying snags causes mean surface fuel loadings in unlogged stands to exceed those in logged stands within 5–10 years after wildfire (Monsanto and Agee, 2008; Keyser et al., 2009; Ritchie et al., 2013; this study).

Post-fire logging was most effective for reducing large diameter surface fuels, consistent with the second hypothesis. By removing tree boles, post-fire logging reduced maximum large diameter fuel loadings and produced a long period of reduced large diameter fuels, including both sound and rotten fuels. Although large diameter fuels may contribute little to fire spread rates (Hyde et al., 2011), they can influence fire residence times and total heat release during fire (Brown et al., 2003; Monsanto and Agee, 2008) and can contribute to large fire growth by promoting greater torching, crowning, and spotting behavior (Brown et al., 2003). Reducing amounts of large, rotten woody fuels may be especially useful, as rotten fuels ignite more easily than sound fuels and smoldering combustion of large diameter rotten fuels can lengthen fire residence times, increase soil heating, increase tree mortality, and produce large amounts of smoke (DeBano et al., 1998; Brown et al., 2003; Monsanto and Agee, 2008). Large rotten woody fuels may also contribute more to surface fire intensities than large sound woody fuels because their greater surface area allows them to function more like smaller diameter fuels (Brown et al., 2003).

Future potential fuel loadings and the effects of post-fire logging on fuels depend, in part, on the mass or volume of trees killed by fire and the amount of material removed during logging. Basal area of firekilled trees, or of snags retained after logging, appears to be a useful scaling factor for predicting fuel loadings through post-fire fuel succession and reductions in fuel loadings from post-fire logging (Ritchie et al., 2013; this study), assuming that tree diameter distributions do not vary radically. Measuring basal area of fire-killed trees could also assist in predicting future fuel loadings in forest stands where wildfires cause only partial overstory mortality (Peterson et al., 2015).

As a fuel reduction treatment, post-fire logging could contribute to long-term restoration objectives in dry coniferous forests by restoring surface fuels to levels more consistent with low and mixed-severity fire regimes. At the stand scale, post-fire logging reduces surface fuels over the longer term, particularly in the large diameter size classes, which should increase management options for applying prescribed fire treatments or allowing future wildfires to burn without causing excessive damage to forest vegetation and soils. Post-fire logging prescriptions could also be designed to generate spatial variability in snag densities and fuels within stands, retaining some snags for wildlife habitat while also creating zones with low fuel loadings to limit the extent of future severe fire behavior. At the landscape scale, post-fire logging could be used to increase heterogeneity in maximum potential fuel loadings, reduce synchrony in fuel succession stages among stands, and influence the relative frequency and spatial distribution of future low, moderate, and high severity fire effects in future fires (Peterson et al., 2015).

Table 13- Predicted surface fuel levels as a function of time since fire for stands with post-fire logging (dashed lines) and without post-fire logging (solid lines), standardized for the median stand basal area of 27 m2 ha−1. Shaded areas indicate periods after wildfire when fuel loadings are not significantly different between treatments (logged or not logged) based on least-square means estimates. (Peterson et al., 2015).



By strategically applying and varying post-fire logging treatments within landscapes, post-fire logging could reduce woody fuels and help reduce threats to human health, property, and ecosystem services from unacceptable future wildfire behavior and effects. If applied using best management practices and with consideration for possible environmental impacts and meeting other management objectives, postfire logging could serve as an effective option – along with mechanical thinning, prescribed fire, and managed low to mixed severity wildfires – for reducing fuels and restoring low and mixed severity fire regimes in dry coniferous forests of western North America and other fire-prone forest types (Peterson et al., 2015).

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17.0 Appendix C Soil Classification

The project area is located within the Franciscan Assemblage. Soils present are listed in Table 1 by map unit number, unit name and acreage.

Table 17

Map unit	Map unit name	Acreage
167	Maymen-Etsel-Mayacama complex, 20 to 60 percent slopes	6530
169 (1690)	Maymen-Etsel-Snook complex, 30 to 75 percent slopes,	6247
170	Maymen-Etsel-Speaker association, 30 to 50 percent slopes	1968
171	Maymen-Hopland-Etsel association, 15 to 50 percent slopes	5024
173	Maymen-Hopland-Mayacama association, 20 to 60 percent slopes, MLRA 15	933
174	Maymen-Hopland-Mayacama association, 50 to 75 percent slopes	5
175	Maymen-Millsholm-Bressa complex, 30 to 50 percent slopes	40
177	Millsholm-Bressa loams, 30 to 50 percent slopes	128
178	Millsholm-Bressa-Hopland association, 30 to 50 percent slopes	224
179	Millsholm-Squawrock-Pomo complex, 30 to 50 percent slopes	33
183	Neuns-Bamtush-Deadwood association, 30 to 50 percent slopes	1525
184	Neuns-Deadwood-Bamtush association, 50 to 75 percent slopes	887
185	Neuns-Decy-Sanhedrin complex, 30 to 50 percent slopes	227
186	Neuns-Sanhedrin-Deadwood complex, 30 to 50 percent slopes	799
187	Neuns-Sanhedrin-Deadwood complex, 50 to 75 percent slopes	159
188	Neuns-Sanhedrin-Speaker gravelly loams, 30 to 50 percent slopes	5293
189	Neuns-Sheetiron-Deadwood complex, 30 to 50 percent slopes	560
192	Okiota-Henneke complex, 5 to 30 percent slopes	36
193	Okiota-Henneke-Dubakella association, 15 to 50 percent slopes	169
198	Pomo-Bressa loams, 15 to 50 percent slopes	100
200	Rock outcrop-Etsel-Snook complex, 50 to 80 percent slopes	724
201	Sanhedrin-Kekawaka-Speaker complex, 15 to 30 percent slopes	87
202	Sanhedrin-Kekawaka-Speaker complex, 30 to 50 percent slopes	1910
224	Speaker-Marpa-Sanhedrin gravelly loams, 30 to 50 percent slopes	1169
225	Speaker-Maymen-Marpa association, 30 to 50 percent slopes	700
226	Speaker-Maymen-Marpa association, 50 to 75 percent slopes	11
229	Speaker-Sanhedrin-Maymen association, 30 to 50 percent slopes	2635
230	Speaker-Speaker variant-Sanhedrin association, 5 to 30 percent slopes	562
231	Squawrock-Shortyork variant gravelly loams, 15 to 30 percent slopes	165
235	Still-Talmage complex, 2 to 8 percent slopes	60
237	Talmage very gravelly sandy loam	206
246	Wolfcreek gravelly loam	71
247	Wolfcreek loam	63

Map unit	Map unit name	Acreage
248	Xerofluvents, very gravelly	26
249	Xerofluvents-Riverwash complex	322
254	Yorkville-Yorktree-Squawrock association, 15 to 50 percent slopes	215

Summary of soil information based on Soil Survey of Lake County, California (USDA)

167 Maymen-Etsel-Mayacama complex, 20 to 60 percent slopes (6530 Acres)

This map unit is on hills and mountains. Elevation is 1,500 to 4,000 feet. Average Annual Precipitation 30 to 50 inches. This unit is about 40 percent Maymen gravelly loam, 20 percent Hopland loam, and 20 percent Mayacama very gravelly sandy loam. The Hopland and Mayacama soils are on north- and east-facing slopes. The Maymen soil is on south- and west-facing slopes and ridgetops.

The vegetation is mainly brush on the Maymen and Etsel soils and hardwoods with scattered conifers on the Mayacama soil. Maymen and Etsel soils main vegetative species are chamise, manzanita, and buckbrush. Canyon live oak, California black oak, and Douglas-fir are the main tree species on the Mayacama soil with California nutmeg and knobcone pine found to a limited extent.

Conifer stands commonly are small and widely scattered, making them generally not suitable for timber harvest.

Prescribed fire may be used to improve wildlife habitat and reduce the risk of fire.

The Maymen soil is shallow and somewhat excessively drained. It formed in material weathered from sandstone or shale. The Hopland soil is moderately deep and well drained. It formed in material weathered from sandstone or shale. The Mayacama soil is moderately deep and somewhat excessively drained. It formed in material weathered from sandstone.

Permeability of the Maymen soil is moderate. Available water capacity is 1 inch to 3 inches. Effective rooting depth is 12 to 20 inches. Permeability of the Etsel soil is moderate. Available water capacity is 0.5 inch to 1.5 inches. Effective rooting depth is 6 to 12 inches. Permeability of the Mayacama soil is moderate. Available water capacity is 1.0 inch to 3.5 inches. Effective rooting depth is 20 to 40 inches.

This unit is used mainly for wildlife habitat and watershed.

690 (1690[4]) Maymen-Etsel-Snook complex, 30 to 75 percent slopes (6247 Acres)

This map unit is on hills and mountains. Elevation is 1,500 to 4,000 feet. The average annual precipitation is 30 to 50 inches. This unit is about 35 percent Maymen gravelly loam, 20 percent Etsel gravelly loam, and 20 percent Snook loam. Areas of the Snook soil at elevations above 3,500 feet are on south-facing slopes. Rock outcroppings and stones 6 inches to 6 feet in diameter are on higher side slopes and ridgetops. The Maymen soil is shallow and somewhat excessively drained. It formed in material weathered from sandstone or shale. Hard, fractured

[4] Map unit number appears as 1690

sandstone is at a depth of 12 inches. The Etsel soil is shallow and somewhat excessively drained. It formed in material weathered from sandstone or shale. Sandstone is at a depth of 8 inches.

Permeability of the Maymen soil is moderate. Available water capacity is 1 inch to 3 inches. Effective rooting depth is 12 to 20 inches. Permeability of the Etsel soil is moderate. Available water capacity is 0.5 inch to 1.5 inches. Effective rooting depth is 6 to 12 inches. The Snook soil is shallow and somewhat excessively drained. If formed in material weathered from sandstone or shale. Fractured sandstone is at a depth of 5 inches. Permeability of the Snook soil is moderate. Available water capacity is 0.5 to 1.0 inch. Effective rooting depth is 4 to 10 inches.

The vegetation is mainly brush with some hardwoods and annual grasses. The natural vegetation on this unit is mainly brush. The species in most areas are mainly chamise, manzanita, and buckbrush. Prescribed burning or chemical or mechanical treatment can be used in small areas to improve habitat for wildlife and reduce the risk of fire.

This unit is used mainly as wildlife habitat and watershed.

170 Maymen-Etsel-Speaker association, 30 to 50 percent slopes (1968 Acres)

This map unit is on mountains. Speaker soil lies on north and east-facing slopes, Maymen and Etsel ridgetops and on south and west-facing slopes. Elevation is 2,000 to 4,000 feet. This unit is about 35 percent Maymen gravelly loam, 30 percent Etsel very gravelly loam, and 20 percent Speaker gravelly loam.

The vegetation is mainly brush on the Maymen and Etsel soils and mixed conifers and hardwoods on the Speaker soil. The Maymen and Etsel soils vegetative species in most areas are mainly chamise, manzanita, and buckbrush The Speaker soil supports Douglas-fir, ponderosa pine, and California black oak. Trees of limited extent are Pacific madrone and knobcone pine. Knobcone pine may dominated some areas because of past fires.

Speaker soil productive potential based of a 100-year site curve, the mean site index is 107 for Douglas-fir and 106 for ponderosa pine. Reforestation can be accomplished by planting and natural regeneration if seed trees are present. Tree survival limiting factors are high soil temperature and low content of soil moisture during the growing season. Common forest understory plants on the Speaker soil are poison-oak, perennial fescue, and bedstraw.

Prescribed fire may be used to improve wildlife habitat and reduce the risk of fire.

The Maymen soil is shallow and somewhat excessively drained. It formed in material weathered from sandstone. Hard, fractured sandstone is at a depth of 12 inches. The Etsel soil is shallow and somewhat excessively drained. It formed in material weathered from sandstone. Fractured sandstone is at a depth of 10 inches. The Speaker soil is moderately deep and well drained. It formed in material weathered from sandstone. Soft sandstone is at a depth of 27 inches.

Permeability of the Maymen soil is moderate. Available water capacity is 1 inch to 3 inches. Effective rooting depth is 12 to 20 inches. Permeability of the Etsel soil is moderate. Available water capacity is 0.5 inch to 1.5 inches. Effective rooting depth is 6 to 12 inches. Permeability of the Speaker soil is moderately slow. Available water capacity is 2 to 6 inches. Effective rooting depth is 20 to 40 inches.

This unit is used mainly for wildlife habitat and watershed.

171 Maymen-Hopland-Etsel association, 15 to 50 percent slopes (5024 Acres)

This map unit is on mountains. Elevation is1,500 to 3,200 feet. This unit is about 30 percent Maymen gravelly loam, 30 percent Hopland loam, and 20 percent Etsel gravelly loam. The Maymen and Etsel soils are on ridgetops and on south- and west-facing slopes. The Hopland soil is on north- and east-facing slopes and in ravines.

The vegetation is mainly brush on the Maymen and Etsel soils, and hardwoods on the Hopland soil. The. The species found on the Maymen and Etsel soils are mainly chamise, manzanita, and buckbrush. The main tree species on the Hopland soil are California black oak, Pacific madrone, and interior live oak. Among the common forest understory plants on Hopland soil are poison-oak, scrub oak, and sparse annual forbs.

Conifer stands are generally not suitable for timber harvest.

Planting conifers on the Hopland soil is not practical because of the restricted available water capacity and high soil temperature in summer. Hardwood reforestation often occurs naturally by sprouting.

Prescribed fire may be used to improve wildlife habitat and reduce the risk of fire.

The Maymen soil is shallow and somewhat excessively drained. It formed in material weathered from sandstone or shale. Hard, fractured sandstone is at a depth of 12 inches. The Hopland soil is moderately deep and well drained. It formed in material weathered from sandstone or shale. Soft, highly weathered sandstone is at a depth of 34 inches. The Etsel soil is shallow and somewhat excessively drained. It formed in material weathered from sandstone or shale. Fractured sandstone is at a depth of 10 inches.

Permeability of the Maymen soil is moderate. Available water capacity is 1 inch to 3 inches. Effective rooting depth is 12 to 20 inches. Permeability of the Maymen soil is moderate. Available water capacity is 1 inch to 3 inches. Effective rooting depth is 12 to 20 inches. Permeability of the Hopland soil is moderately slow. Available water capacity is 3 to 7 inches. Effective rooting depth is 20 to 40 inches.

This unit is used mainly for wildlife habitat and watershed.

173: Maymen-Hopland-Mayacama association, 30 to 50 percent slopes. (933 Acres)

This map unit is on hills and mountains. Rock outcroppings and stones 6 to 25 feet in diameter occur randomly throughout the unit. Elevation is 1,500 to 3,500 feet. The average annual precipitation is 30 to 50 inches. This unit is about 40 percent Maymen gravelly loam, 20 percent Hopland loam, and 20 percent Mayacama very gravelly sandy loam. The Hopland and Mayacama soils are on north- and east-facing slopes. The Maymen soil is on south- and west-facing slopes and ridgetops.

The vegetation is mainly brush and annual grasses on the Maymen soil and brush and hardwoods with a few conifers on the Hopland and Mayacama soils. The natural vegetation on the Maymen soil is mainly brush. The primary species in most areas are chamise, manzanita, and buckbrush. California black oak, Pacific madrone, and interior live oak are the main tree species on the Mayacama and Hopland soils. Among the trees of limited extent are Douglas-fir and California-laurel on the Mayacama soil. Typical understory plants on these soils are California nutmeg, scrub oak, and poison-oak.

Conifer stands are generally not suitable for timber harvest.

Planting conifers on the Hopland and Mayacoma soils is not practical because of the restricted available water capacity and high soil temperature in summer. Hardwood reforestation often occurs naturally by sprouting.

Prescribed fire may be used to improve wildlife habitat and reduce the risk of fire.

The Maymen soil is shallow and somewhat excessively drained. It formed in material weathered from sandstone or shale. Hard, fractured sandstone is at a depth of 12 inches. The Hopland soil is moderately deep and well drained. It formed in material weathered from sandstone or shale. Soft, highly weathered sandstone is at a depth of 34 inches. The Mayacama soil is moderately deep and somewhat excessively drained. It formed in material weathered from sandstone. Hard, fractured sandstone is at a depth of 31 inches.

Permeability of the Maymen soil is moderate. Available water capacity is 1 inch to 3 inches. Effective rooting depth is 12 to 20 inches. Permeability of the' Hopland soil is moderately slow. Available water capacity is 3 to 7 inches. Effective rooting depth is 20 to 40 inches. Permeability of the Mayacama soil is moderate. Available water capacity is 1 inch to 3.5 inches. Effective rooting depth is 20 to 40 inches.

This unit is used mainly for wildlife habitat and watershed.

174 Maymen-Hopland-Mayacama association, 50 to 75 percent slopes (5 Acres)

This map unit is on hills and mountains. Rock outcroppings and stones 6 to 25 feet in diameter occur randomly throughout the unit. Elevation is 1,500 to 3,500 feet. The average annual precipitation is 30 to 50 inches. This unit is about 40 percent Maymen gravelly loam, 20 percent Hopland loam, and 20 percent Mayacama very gravelly sandy loam. The Hopland and Mayacama soils are on north- and east-facing slopes. The Maymen soil is on south- and west-facing slopes and ridgetops.

The vegetation is mainly brush and annual grasses on the Maymen soil and brush and hardwoods with a few conifers on the Hopland and Mayacama soils. The natural vegetation on the Maymen soil is mainly brush. The primary species in most areas are chamise, manzanita, and buckbrush. California black oak, Pacific madrone, and interior live oak are the main tree species on the Mayacama and Hopland soils. Among the trees of limited extent are Douglas-fir and California-laurel on the Mayacama soil. Typical understory plants on these soils are California nutmeg, scrub oak, and poison-oak.

Conifer stands are generally not suitable for timber harvest.

Planting conifers on the Hopland and Mayacoma soils is not practical because of the restricted available water capacity and high soil temperature in summer. Hardwood reforestation often occurs naturally by sprouting.

Prescribed fire may be used to improve wildlife habitat and reduce the risk of fire.

The Maymen soil is shallow and somewhat excessively drained. It formed in material weathered from sandstone or shale. Hard, fractured sandstone is at a depth of 12 inches. The Hopland soil is moderately deep and well drained. It formed in material weathered from sandstone or shale. Soft, highly weathered sandstone is at a depth of 34 inches. The Mayacama soil is moderately deep and somewhat excessively drained. It formed in material weathered from sandstone. Hard, fractured sandstone is at a depth of 31 inches.

Permeability of the Maymen soil is moderate. Available water capacity is 1 inch to 3 inches. Effective rooting depth is 12 to 20 inches. Permeability of the' Hopland soil is moderately slow. Available water capacity is 3 to 7 inches. Effective rooting depth is 20 to 40 inches. Permeability of the Mayacama soil is moderate. Available water capacity is 1 inch to 3.5 inches. Effective rooting depth is 20 to 40 inches.

This unit is used mainly for wildlife habitat and watershed.

175 Maymen-Millsholm-Bressa complex, 30 to 50 percent slopes. (40 Acres)

This map unit is on hills. Rock outcrop and stones 10 inches to 2 feet in diameter are on the upper part of south-facing slopes and on ridgetops. Elevation is 1,400 to 3,000 feet. The average annual precipitation is 30 to 40 inches. This unit is about 30 percent Maymen gravelly loam, 20 percent Millsholm loam, and 15 percent Bressa loam.

The vegetation is mainly brush and annual grasses on the Maymen soil and oaks and annual grasses on the Millsholm and Bressa soils.

Prescribed fire may be used to improve wildlife habitat and reduce the risk of fire.

The Maymen soil is shallow and somewhat excessively drained. It formed in material weathered from sandstone or shale. Hard, fractured sandstone is at a depth of 12 inches. The Millsholm soil is shallow and well drained. It formed in material weathered from sandstone or shale. Fractured sandstone is at a depth of 11 inches. The Bressa soil is moderately deep and well drained. It formed in material weathered from sandstone. Fractured sandstone is at a depth of 26 inches.

Permeability of the Maymen soil is moderate. Available water capacity is 1 inch to 3 inches. Effective rooting depth is 12 to 20 inches. Permeability of the Millsholm soil is moderate. Available water capacity is 1.5 to 3.5 inches. Effective rooting depth is 10 to 20 inches. Permeability of the Bressa soil is moderately slow. Available water capacity is 3.0 to 7.5 inches. Effective rooting depth is 20 to 40 inches.

This unit is used mainly for wildlife habitat and watershed.

177 Millsholm-Bressa loams, 30 to 50 percent slopes (128 Acres)

This map unit is on hills. Elevation is 1,200 to 2,500 feet. The average annual precipitation is 30 to 40 inches. This unit is about 45 percent Millsholm loam and 35 percent Bressa loam.

The vegetation is mainly annual grasses, oaks, and brush. Among the common understory plants are soft chess, wild oat, and filaree.

The Millsholm soil is shallow and well drained. It formed in material weathered from sandstone or shale. Fractured sandstone is at a depth of 18 inches. The Bressa soil is moderately deep and well drained. It formed in material weathered from sandstone. Fractured sandstone is at a depth of 26 inches.

Permeability of the Millsholm soil is moderate. Available water capacity is 1.5 to 3.5 inches. Effective rooting depth is 10 to 20 inches. Permeability of the Bressa soil is moderately slow. Available water capacity is 3.0 to 7.5 inches. Effective rooting depth is 20 to 40 inches.

This unit is used mainly for livestock grazing, wildlife habitat, and watershed.

178-Millsholm-Bressa-Hopland association, 30 to 50 percent slopes (224 Acres)

This map unit is on hills. The Hopland soil is on north- and east-facing slopes, and the Millsholm and Bressa soils are on south-facing slopes. Elevation is 1,400 to 3,000 feet. The average annual precipitation is 30 to 40 inches. This unit is about 35 percent Millsholm loam, 20 percent Bressa loam, and 15 percent Hopland loam.

The vegetation is mainly brush and annual grasses on the Millsholm and Bressa soils and hardwood trees and annual grasses on the Hopland soil.

The Millsholm soil is shallow and well drained. It formed in material weathered from sandstone or shale. Fractured sandstone is at a depth of 18 inches. The Bressa soil is moderately deep and well drained. It formed in material weathered from sandstone. Fractured sandstone is at a depth of 26 inches. The

Hopland soil is moderately deep and well drained. It formed in material weathered from sandstone or shale. Soft, highly weathered sandstone is at a depth of 34 inches..

Permeability of the Millsholm soil is moderate. Available water capacity is 1.5 to 3.5 inches. Effective rooting depth is 10 to 20 inches. Permeability of the Bressa soil is moderately slow. Available water capacity is 3.0 to 7.5 inches. Effective rooting depth is 20 to 40 inches. Permeability of the Hopland soil is moderately slow. Available water capacity is 3 to 7 inches. Effective rooting depth is 20 to 40 inches.

This unit is used mainly for livestock grazing, wildlife habitat, and watershed. It is also used for firewood production.

179 Millsholm-Squawrock-Pomo complex, 30 to 50 percent slopes (33 Acres)

This map unit is on hills and mountains. The Pomo soils are susceptible to slumping. Elevation is 1,400 to 3,000 feet. The average annual precipitation is 30 to 40 inches. This unit is about 30 percent Millsholm loam, 30 percent Squawrock gravelly loam, and 20 percent Pomo loam.

The vegetation is mainly annual grasses with scattered oaks and brush on the Millsholm and Squawrock soils and annual grasses on the Pomo soil.

The Millsholm soil is shallow and well drained. It formed in material weathered from sandstone or shale. The Squawrock soil is moderately deep and well drained. It formed in material weathered from sandstone. Sandstone is at a depth of 37 inches. The Pomo soil is deep and well drained. It formed in material weathered from sandstone. Fractured, weathered sandstone is at a depth of 58 inches.

Permeability of the Millsholm soil is moderate. Available water capacity is 1.5 to 3.5 inches. Effective rooting depth is 10 to 20 inches. Permeability of the Squawrock soil is moderate. Available water capacity is 1.5 to 4.5 inches. Effective rooting depth is 20 to 40 inches. Permeability of the Pomo soil is moderately slow. Available water capacity is 4.0 to 8.5 inches. Effective rooting depth is 40 to 60 inches.

This unit is used mainly for livestock grazing, wildlife habitat, and watershed. Springs and seeps are common on this unit. Hard, fractured sandstone is at a depth of 11 inches.

183 Neuns-Bamtush-Deadwood association, 30 to 50 percent slopes (1525 Acres)

This map unit is on mountains. The Neuns and Bamtush soils are on side slopes, toe slopes, and benches. The Deadwood soil is on ridges. Elevation is 3,000 to 5,000 feet. The average annual precipitation is 45 to 60 inches. This unit is about 35 percent Neuns gravelly loam, 25 percent Bamtush gravelly loam, and 20 percent Deadwood very gravelly sandy loam. The vegetation is mainly conifers and hardwoods on the Neuns and Bamtush soils and shrubs and hardwoods with scattered conifers on the Deadwood soil.

Among the common forest understory plants are serviceberry, gooseberry, bracken fern, and perennial fescue.

The Neuns soil is moderately deep and well drained. It formed in material weathered from metamorphosed sandstone throughout most of the survey area and from greenstone in the Snow Mountain area. Hard, fractured metamorphosed sandstone is at a depth of 31 inches. The Bamtush soil is very deep and well drained. It formed in material weathered from sandstone throughout most of the survey area and from greenstone in the Snow Mountain area. The Deadwood soil is shallow and somewhat excessively drained. It formed in material weathered from sandstone throughout most of the survey area and from greenstone in the Snow Mountain area. Hard, fractured sandstone is at a depth of 13 inches.

Permeability of the Neuns soil is moderate. Available water capacity is 1.0 inch to 3.5 inches. Effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the hazard of erosion is severe. Permeability of the Bamtush soil is moderate. Available water capacity is 5.0 to 7.5 inches. Effective rooting depth is 60 inches or more. Permeability of the Deadwood soil is moderately rapid. Available water capacity is 0.5 to 1.0 inch. Effective rooting depth is 10 to 20 inches.

Douglas-fir, ponderosa pine, and California black oak are the main tree species on the Neuns and Bamtush soils. Canyon live oak and scattered Douglas-fir and ponderosa pine are the main tree species on the Deadwood soil. Among the trees of limited extent are sugar pine, Pacific madrone, and white fir. On the basis of a 100-year site curve, the mean site index for Douglas-fir is 113 on the Neuns soil, 134 on the Bamtush soil, and 83 on the Deadwood soil. On the basis of a 100-year site curve, the mean site index for ponderosa pine is 106 on the Neuns soil, 139 on the Bamtush soil, and 84 on the Deadwood soil.

Seedling survival is a concern in the reforestation and production of timber on this unit. The droughtiness of the surface layer reduces the survival rate of seedlings, especially in areas of the Neuns and Deadwood soils on south- and southwest-facing slopes. Plantings on the Deadwood soil have a low chance of survival because of the restricted available water capacity. Reforestation of the Neuns and Bamtush soils can be accomplished by Soil Survey planting ponderosa pine and Douglas-fir seedlings. If seed trees are present, natural reforestation by conifers frequently occurs on the Neuns and Bamtush soils.

This unit is used mainly for timber production, wildlife habitat, and watershed.

184 Neuns-Deadwood-Bamtush association, 50 to 75 percent slopes (887 Acres)

This map unit is on mountains. Elevation is 3,000 to 5,000 feet. The average annual precipitation is 45 to 60 inches. This unit is about 35 percent Neuns gravelly loam, 25 percent Deadwood very gravelly sandy loam, and 20 percent Bamtush gravelly loam. The Neuns and Bamtush soils are on side slopes, toe slopes, and benches. The Deadwood soil is on ridgetops.

The vegetation is mainly conifers and hardwoods on the Neuns and Bamtush soils and brush and hardwoods with scattered confiers on the Deadwood soil. Douglas-fir, ponderosa pine, and California black oak are the main tree species on the Neuns and Bamtush soils. Canyon live oak and scattered Douglas-fir and ponderosa pine are the main tree species on the Deadwood soil. Among the trees of limited extent are sugar pine, white fir, and Pacific madrone. On the basis of a 100-year site curve, the mean site index for Douglas-fir is 113 on the Neuns soil, 83 on the Deadwood soil, and 134 on the Bamtush soil. On the basis of a 1 DO-year site curve, the mean site index for ponderosa pine is 106 on the Neuns soil, 84 on the Deadwood soil, and 139 on the Bamtush soil.

Among the common forest understory plants are brushy live oak, California nutmeg, and scattered annual forbs. Gooseberry and serviceberry are present on the Bamtush soil.

Seedling survival is a concern in the reforestation and production of timber on this unit. The droughtiness of the surface layer reduces the survival rate of seedlings, especially in areas of the Neuns and Deadwood soils on south- and southwest-facing slopes. Plantings on the Deadwood soil have a low chance of survival because of the restricted available water capacity. Reforestation of the Neuns and Bamtush soils can be accomplished by planting ponderosa pine and Douglasfir seedlings. If seed trees are present, natural reforestation by conifers frequently occurs on the Neuns and Bamtush soils.

The Neuns soil is moderately deep and well drained. It formed in material weathered from metamorphosed sandstone throughout most of the survey area and from greenstone in the Snow Mountain area. Hard, fractured metamorphosed sandstone is at a depth of 31 inches. The Deadwood soil is shallow and somewhat excessively drained. It formed in material weathered from sandstone throughout most of the survey area and from greenstone in the Snow Mountain area. Hard, fractured sandstone is at a depth of 13 inches. The Bamtush soil is very deep and well drained. It formed in material weathered from sandstone throughout most of the survey area and from greenstone in the Snow Mountain area.

Permeability of the Neuns soil is moderate. Available water capacity is 1.0 inch to 3.5 inches. Effective rooting depth is 20 to 40 inches. Permeability of the Deadwood soil is moderately rapid. Available water capacity is 0.5 to 1.0 inch. Effective rooting depth is 10 to 20 inches.

This unit is used mainly for timber production, wildlife habitat, and watershed.

185 Neuns-Decy-Sanhedrin complex, 30 to 50 percent slopes (227 Acres)

This map unit is on mountains. Elevation is 2,800 to 5,000 feet. The average annual precipitation is 40 to 60 inches. This unit is about 35 percent Neuns gravelly loam, 30 percent Decy gravelly sandy loam, and 15 percent Sanhedrin gravelly loam. The Decy soil occurs at elevations of more than 3,500 feet.

The vegetation is mainly mixed conifers and hardwoods with some shrubs. Ponderosa pine, Douglas-fir, live oak, and California black oak are the main tree species on the Neuns soil. On the basis of a 100-year site curve, the mean site index is 106 for ponderosa pine and 113 for Douglas-fir. Ponderosa pine, Douglas-fir, California black oak, and Pacific madrone are the main tree species on the Decy and Sanhedrin soils. On the basis of a 100-year site curve, the mean site index for ponderosa pine is 106 on the Decy soil and 116 on the Sanhedrin soil. On the basis of a 100-year site curve, the mean site index for Douglas-fir is 101 on the Decy soil and 121 on the Sanhedrin soil.

Among the common forest understory plants are perennial fescue, bedstraw, poison-oak, and gooseberry.

Seedling establishment is a concern in the production of timber on the Neuns and Decy soils. The droughtiness of the surface layer reduces the survival rate of seedlings, especially on south- and southwest-facing slopes. Plant competition is a concern in the reforestation of the Sanhedrin soil. When openings are made in the canopy, invading brushy plants that are not controlled can prevent the establishment of seedlings. Reforestation can be accomplished by planting Douglasfir and ponderosa pine seedlings on this unit. If seed trees are present, natural reforestation by conifers frequently occurs on the Sanhedrin soil but is less reliable on the Neuns and Decy soils.

The Neuns soil is moderately deep and well drained. It formed in material weathered from metamorphosed sandstone throughout most of the survey area and from greenstone in the Snow Mountain area. Hard, fractured metamorphosed sandstone is at a depth of 31 inches. The Decy soil is moderately deep and well drained. It formed in material weathered from sandstone and shale. Hard sandstone and shale are at a depth of 24 inches. The Sanhedrin soil is deep and well drained. It formed in material weathered from sandstone. Weathered sandstone is at a depth of 57 inches.

Permeability of the Neuns soil is moderate. Available water capacity is 1.0 inch to 3.5 inches. Effective rooting depth is 20 to 40 inches. Permeability of the Decy soil is moderately rapid. Available water capacity is 1.5 to 4.0 inches. Effective rooting depth is 20 to 40 inches. Permeability of the Sanhedrin soil is moderately slow. Available water capacity is 4 to 8 inches. Effective rooting depth is 40 to 60 inches.

This unit is used mainly for timber production, wildlife habitat, and watershed.

186 Neuns-Sanhedrin-Deadwood complex, 30 to 50 percent slopes (799 Acres)

This map unit is on mountains. Elevation is 3,000 to 5,000 feet. The average annual precipitation is 40 to 60 inches. This unit is about 40 percent Neuns gravelly loam, 25 percent Sanhedrin gravelly loam, and 15 percent Deadwood very gravelly sandy loam.

The vegetation is mainly mixed conifers and hardwoods with some shrubs. Ponderosa pine, Douglas-fir, and California black oak are the main tree species in areas where the Neuns soil is on north-facing slopes and at higher elevations. Canyon live oak and California nutmeg are dominant in hot, dry areas of the Neuns soil. On the basis of a 100-year site curve, the mean site index is 113 for Douglas-fir and 106 for ponderosa pine. Low stocking of the main commercial species generally reduces the yield substantially in the hotter areas. Douglas-fir, ponderosa pine, sugar pine, and California black oak are the main tree species on the Sanhedrin soil. On the basis of a 100-year site curve, the mean site index is 121 for Douglas-fir and 116 for ponderosa pine. Canyon live oak is the main tree species on the Deadwood soil. Among the trees of limited extent are ponderosa pine, Douglas-fir, and sugar pine. On the basis of a 100-year site curve, the mean site index is 84 for ponderosa pine.

Seedling survival is a concern in the production of timber on the Neuns and Deadwood soils. The droughtiness of the surface layer reduces the survival rate of seedlings, especially on south- and southwestfacing slopes. Natural reforestation by Douglas-fir occurs infrequently. Proper site preparation on the Neuns soil is neccessary to replace stands of brush and hardwoods with conifers. Reforestation of the Neuns soil can be accomplished by planting Douglas-fir, ponderosa pine, and sugar pine seedlings. Planting on the Deadwood soil is not practical because of the high content of rocks and the shallow depth of the soil. Plant competition is a concern in the production of timber on the Sanhedrin soil. When openings are made in the canopy, invading brushy plants that are not controlled can prevent the establishment of seedlings. Reforestation can be accomplished by planting Douglas-fir, ponderosa pine, and sugar pine seedlings. If seed trees are present, natural reforestation by Douglas-fir frequently occurs.

Among the common forest understory plants are wild pea, nutmeg, California fescue, and manzanita.

The Neuns soil is moderately deep and well drained. It formed in material weathered from metamorphosed sandstone throughout most of the survey area and from greenstone in the Snow Mountain area. Hard, fractured metamorphosed sandstone is at a depth of 31 inches. The Sanhedrin soil is deep and well drained. It formed in material weathered from sandstone. Weathered sandstone is at a depth of 57 inches. The Deadwood soil is shallow and somewhat excessively drained. It formed in material weathered from sandstone. Hard sandstone is at a depth of 13 inches.

Permeability of the Neuns soil is moderate. Available water capacity is 1.0 inch to 3.5 inches. Effective rooting depth is 20 to 40 inches. Permeability of the Sanhedrin soil is moderately slow. Available water capacity is 4 to 8 inches. Effective rooting depth is 40 to 60 inches. Permeability of the Deadwood soil is moderately rapid. Available water capacity is 0.5 to 1.0 inch. Effective rooting depth is 10 to 20 inches.

This unit is used mainly for timber production, wildlife habitat, and watershed

187 Neuns-Sanhedrin-Deadwood complex, 50 to 75 percent slopes (159 Acres)

This map unit is on mountains. Elevation is 3,000 to 5,000 feet. The average annual precipitation is 40 to 60 inches. This unit is about 40 percent Neuns gravelly loam, 20 percent Sanhedrin gravelly loam, and 20 percent Deadwood very gravelly sandy loam.

The vegetation is mainly mixed conifers and hardwoods with some shrubs. Ponderosa pine, Douglas-fir, and California black oak are the main tree species in areas of the Neuns soil on north-facing slopes and at higher elevations. Canyon live oak and California nutmeg are dominant in hot, dry areas of the Neuns soil. On the basis of a 100-year site curve, the mean site index is 113 for Douglas-fir and 106 for ponderosa pine. Douglas-fir, ponderosa pine, sugar pine, and California black oak are the main tree species on the Sanhedrin soil. On the basis of a 100-year site curve, the mean site index is 121 for Douglas-fir and 116 for ponderosa pine. Canyon live oak is the main tree species on the Deadwood soil. Among the trees of limited extent are ponderosa pine, Douglas-fir, and sugar pine. On the basis of a 100-year site curve, the mean site index is 84 for ponderosa pine.

Among the common forest understory plants are wild pea, nutmeg, California fescue, and manzanita. This unit is used mainly for timber production, wildlife habitat, and watershed.

The Neuns soil is moderately deep and well drained. It formed in material weathered from metamorphosed sandstone throughout most of the survey area and from greenstone in the Snow Mountain area. Hard, fractured metamorphosed sandstone is at a depth of 31 inches. The Sanhedrin soil is deep and well drained. It formed in material weathered from sandstone. Weathered sandstone is at a depth of 57 inches. The Deadwood soil is shallow and somewhat excessively drained. It formed in material weathered from sandstone. Hard sandstone is at a depth of 13 inches.

Permeability of the Neuns soil is moderate. Available water capacity is 1.0 inch to 3.5 inches. Effective rooting depth is 20 to 40 inches. Permeability .Of the Sanhedrin soil is moderately slow. Available water capacity is 4 to 8 inches. Effective rooting depth is 40 to 60 inches. Permeability of the Deadwood soil is moderately rapid. Available water capacity is 0.5 to 1.0 inch. Effective rooting depth is 10 to 20 inches.

Seedling survival is a concern in the production of timber on the Neuns and Deadwood soils. The droughtiness of the surface layer reduces the survival rate of seedlings, especially on south- and southwest facing slopes. Reforestation of the Neuns soil can be accomplished by planting Douglas-fir, ponderosa pine, and sugar pine seedlings. Planting on the Deadweod soil is not practical because of the high content of rock and the shallow depth of the soil. Plant competition is a concern in the production of timber on the Sanhedrin soil. When openings are made in the canopy, invading brushy plants that are not controlled can prevent the establishment of seedlings. Reforestation can be accomplished by planting Douglas-fir, ponderosa pine, and sugar pine seedlings. If seed trees are present, natural reforestation by Douglas-fir and ponderosa pine frequently .Occurs.

This unit is used mainly for timber production, wildlife habitat, and watershed.

188 Neuns-Sanhedrin-Speaker gravelly loams, 30 to 50 percent slopes (5293 Acres)

This map unit is on mountains. Elevation is 2,200 to 4,000 feet. The average annual precipitation is 40 to 60 inches. This unit is about 35 percent Neuns gravelly loam, 30 percent Sanhedrin gravelly loam, and 20 percent Speaker gravelly loam.

The vegetation is mainly mixed conifers and hardwoods. Permeability of the Neuns soil is moderate. Available water capacity is 1.0 inch to 3.5 inches. Effective rooting depth is 20 to 40 inches. Ponderosa pine, Douglas-fir, California black oak, and canyon live oak are the main tree species on the Neuns soil. On the basis of a 100-year site curve, the mean site index is 106 for ponderosa pine and 113 for Douglas-fir. Ponderosa pine, Douglas-fir, California black oak, and Pacific madrone are the main tree species on the Sanhedrin and Speaker soils. On the basis of a 100-year site curve, the mean site index for ponderosa pine is 116 on the Sanhedrin soil and 106 on the Speaker soil. On the basis of a 100-year site curve, the mean site index for Douglas-fir is 121 on the Sanhedrin soil and 107 on the Speaker soil.

Among the common forest understory plants are wild pea, mountain brome, California fescue, and manzanita.

Seedling establishment is a concern in the production of timber on the Neuns soil. The droughtiness of the surface layer reduces the survival rate of seedlings, especially on south- and southwest-facing slopes. Reforestation can be accomplished by planting Douglasfir seedlings on cool aspects and ponderosa pine in other areas. On the Sanhedrin and Speaker soils, plant competition is a concern in the production of timber. When openings are made in the canopy, invading brushy plants that are not controlled can delay the establishment of seedlings. Reforestation of the Sanhedrin and Speaker soils can be accomplished by planting Douglas-fir and ponderosa pine seedlings. If seed trees are present, natural reforestation by Douglas-fir frequently occurs on this unit.

The Neuns soil is moderately deep and well drained. It formed in material weathered from metamorphosed sandstone throughout most of the survey area and from greenstone in the Snow Mountain area. Hard, fractured metamorphosed sandstone is at a depth of 31 inches. The Sanhedrin soil is deep and well drained. It formed in material weathered from sandstone. Weathered sandstone is at a depth of 57 inches. The Speaker soil is moderately deep and well drained. It formed in material weathered from sandstone. Soft sandstone is at a depth of 27 inches.

Permeability of the Sanhedrin soil is moderately slow. Available water capacity is 4 to 8 inches. Effective rooting depth is 40 to 60 inches. Permeability of the Speaker soil is moderately slow. Available water capacity is 2 to 6 inches. Effective rooting depth is 20 to 40 inches.

This unit is used mainly for timber production, wildlife habitat, and watershed.

189 Neuns-Sheetiron-Deadwood complex, 30 to 50 percent slopes (560 Acres)

This map unit is on mountains. Elevation is 3,200 to 5,000 feet. The average annual precipitation is 40 to 60 inches. This unit is about 30 percent Neuns gravelly loam, 25 percent Sheetiron gravelly sandy loam, and 15 percent Deadwood very gravelly sandy loam.

The vegetation is mainly mixed conifers, hardwoods, and shrubs. Ponderosa pine, Douglas-fir, interior live oak, and California black oak are the main tree species on this unit. Interior live oak is the dominant tree on the Deadwood soil. Among the trees of limited extent are incense-cedar, white fir, and sugar pine. On the basis of a 100-year site curve, the mean site index for ponderosa pine is 106 on the Neuns soil, 105 on the Sheetiron soil, and 84 on the Deadwood soil. On the basis of a 1 00-year site curve, the mean site index for Douglas-fir is 113 on the Neuns soil, 105 on the Sheetiron soil, and 83 on the Deadwood soil. Seedling survival is a concern in the production of timber on this unit. The droughtiness of the surface layer reduces the survival rate of seedlings, especially on south- and southwest-facing slopes. Even when seed trees are present, natural reforestation of cutover areas by Douglas-fir, ponderosa pine, white fir, and incense cedar occurs infrequently on this unit. Reforestation can be accomplished by planting ponderosa pine and Douglas-fir. Planting on the Deadwood soil is not practical because of the high content of rock and restricted available water capacity of the soil.

Among the common forest understory plants are bedstraw, perennial fescue, poison-oak, and nutmeg.

The Neuns soil is moderately deep and well drained. It formed in material weathered from metamorphosed sandstone throughout most of the survey area and from greenstone in the Snow Mountain area. Hard, fractured metamorphosed sandstone is at a depth of 31 inches. The Sheetiron soil is moderately deep and well drained. It formed in material weathered from mica quartz schist. The Deadwood soil is shallow and somewhat excessively drained. It formed in material weathered from sandstone. Hard sandstone is at a depth of 13 inches.

Permeability of the Neuns soil is moderate. Available water capacity is 1.0 inch to 3.5 inches. Effective rooting depth is 20 to 40 inches. Permeability of the Sheetiron soil is moderate. Available water capacity is 1.5 to 4.0 inches. Effective rooting depth is 20 to 40 inches. Permeability of the Deadwood soil is moderately rapid. Available water capacity is 0.5 to 1.0 inch. Effective rooting depth is 10 to 20 inches.

This unit is used mainly for timber production, wildlife habitat, and watershed.

192 Okiota-Henneke complex, 5 to 30 percent slopes (36 Acres)

This map unit is on hills and mountains. Elevation is 1,100 to 3,500 feet. The average annual precipitation is 25 to 40 inches. This unit is about 45 percent Okiota very gravelly clay loam and 35 percent Henneke gravelly loam.

The vegetation is mainly brush with an understory of sparse annual grasses. The natural vegetation on this unit is mainly brush because of the limited soil depth, restricted available water capacity, nutrient imbalances, and climate. The vegetation in most areas is mainly chamise, manzanita. and scrub oak. Properly planned and prescribed burning or chemical or mechanical treatment can be used in small areas to improve habitat for wildlifeand reduce the risk of fire.

The Okiota soil is shallow and well drained. It formed in material weathered from serpentinitic rock. The Henneke soil is shallow and somewhat excessively drained. It formed in material weathered from serpentinitic rock.

Permeability of the Okiota soil is slow. Available water capacity is 1.5 to 3.0 inches. Effective rooting depth is 10 to 20 inches. Permeability of the Henneke soil is moderately slow. Available water capacity is 1 inch to 2 inches. Effective rooting depth is 10 to 20 inches.

This unit is used mainly as wildlife habitat and watershed

193 Okiota-Henneke-Dubakella association, 15 to 50 percent slopes (169 Acres)

This map unit is on hills and mountains. Rock outcroppings and stones 6 inches to 25 feet in diameter occur randomly throughout the unit. Elevation is 1.100 to 3.500 feet. The average annual precipitation is 25 to 45 inches. This unit is about 30 percent Okiota very gravelly clay loam. 25 percent Henneke gravelly loam, and 25 percent Dubakella very gravelly loam. The Dubakella soil is on north-facing slopes, and the Okiota and Henneke soils are on south-facing slopes.

The vegetation is mainly brush on the Okiota and Henneke soils and brush with a few scattered conifers on the Dubakella soil.

The Okiota soil is shallow and well drained. It formed in material weathered from serpentinitic rock. The Henneke soil is shallow and somewhat excessively drained. It formed in material weathered from serpentinitic rock. The Dubakella soil is moderately deep and well drained. It formed in material weathered from serpentinite and peridotite.

Permeability of the Okiota soil is slow. Available water capacity is 1.5 to 3.0 inches. Effective rooting depth is 10 to 20 inches. Permeability of the Henneke soil is moderately slow. Available water capacity is 1 inch to 2 inches. Effective rooting depth is 10 to 20 inches. Permeability of the Dubakella soil is slow. Available water capacity is 1.5 to 4.0 inches. Effective rooting depth is 20 to 40 inches.

The vegetation is mainly brush on the Okiota and Henneke soils and brush with a few scattered conifers on the Dubakella soil. The natural vegetation on this unit is mainly brush because of limited soil depth, restricted available water capacity, nutrient imbalances and climate. The vegetation in most areas is mainly chamise, manzanita and scrub oak.

This unit is used mainly as wildlife habitat and watershed

198 Pomo-Bressa loams, 15 to 50 percent slopes (100 Acres)

This map unit is on hills. The Pomo soils are susceptible to slumping. Elevation is 1,400 to 3,000 feet. The average annual precipitation is 30 to 40 inches. This unit is about 60 percent Pomo loam and 15 percent Bressa loam.

The Porno soil is deep and well drained. It formed in material weathered from sandstone. The Bressa soil is moderately deep and well drained. It formed in material weathered from sandstone.

Permeability of the Pomo soil is moderately slow. Available water capacity is 4.0 to 8.5 inches. Effective rooting depth is 40 to 60 inches. Permeability of the Bressa soil is moderately slow. Available water capacity is 3.0 to 7.5 inches. Effective rooting depth is 20 to 40 inches.

The vegetation is mainly annual grasses and forbs and scattered stands of oak. The characteristic plant community on the Pomo soil is mainly soft chess, purple needlegrass, and filaree. Among the common understory plants on the Bressa soil are wild oat, soft chess, and blue wild rye.

This unit is used mainly for livestock grazing, wildlife habitat, and watershed.

200 Rock outcrop-Etsel-Snook complex, 50 to 80 percent slopes (724 Acres)

This map unit is on hills and. mountains. Elevation is 1,400 to 4,000 feet. The average annual precipitation is 30 to 50 inches. This unit is about 60 percent Rock outcrop, 15 percent Etsel gravelly loam, and 15 percent Snook loam. Areas of the Snook soil at elevations of more than 3,500 feet are on south-facing slopes. Rock outcrop consists of exposed areas of hard, unweathered sandstone. It occurs on ridgetops and side slopes as intruding bedrock or as detached masses of rock. Outcroppings are 100 feet in diameter to 5 acres in diameter.

The vegetation is mainly brush and sparse annual grasses. The natural vegetation on this unit is mainly brush. Because of the instability of the Etsel soil, vegetation should be retained for erosion control and to provide wildlife habitat.

The Etsel soil is shallow and somewhat excessively drained. It formed in material weathered from sandstone. The Snook soil is shallow and somewhat excessively drained. It formed in material weathered from sandstone or shale.

Permeability of the Etsel soil is moderate. Available water capacity is 0.5 inch to 1.5 inches. Effective rooting depth is 6 to 12 inches. Permeability of the Snook soil is moderate. Available water capacity is 0.5 to 1.0 inch. Effective rooting depth is 4 to 10 inches.

This unit is used mainly as wildlife habitat and watershed.

201 Sanhedrin-Kekawaka-Speaker complex, 15 to 30 percent slopes (87 Acres)

This map unit is on mountains. Elevation is 2,200 to 4,800 feet. The average annual precipitation is 40 to 60 inches. This unit is about 35 percent Sanhedrin gravelly loam, 30 percent Kekawaka loam, and 15 percent Speaker gravelly loam.

The vegetation is mainly mixed conifers and hardwoods. Douglas-fir, sugar pine, ponderosa pine, California black oak, and Pacific madrone are the main tree species on this unit. On the basis of a 100-year site curve, the mean site index for Douglas-fir is 121 on the Sanhedrin soil, 154 on the Kekawaka soil, and 107 on the Speaker soil. On the basis of a 100-year site curve, the mean site index for ponderosa pine is 116 on the Sanhedrin soil, 147 on the Kekawaka soil, and 106 on the Speaker soil. The potential annual production of ponderosa pine on the Sanhedrin soil is 530 board feet per acre from a fully stocked stand of trees. The potential annual production of ponderosa pine on the Kekawaka soil is 945 board feet per acre from a fully stocked stand of trees. The potential annual production of ponderosa pine on the Speaker soil is 425 board feet per acre from a fully stocked stand of trees. In many areas, the Kekawaka soil has a rather abrupt boundary between the surface layer and the clay subsoil. In those areas, productivity is much lower; the average site index

Among the common forest understory plants are bedstraw, rose, manzanita, and annual forbs.

Plant competition is a concern in the reforestation and production of timber. When openings are made in the canopy, invading brushy plants that are not controlled can prevent the establishment of seedlings. Reforestation can be accomplished by planting Douglasfir, ponderosa pine, and sugar pine seedlings. If seed trees are present, natural reforestation by conifers frequently occurs. is 106 for Douglas-fir and 113 for ponderosa pine.

The Sanhedrin soil is deep and well drained. It formed in material weathered from sandstone. Sandstone is at a depth of 57 inches. The Kekawaka soil is very deep and well drained. It formed in material weathered from sandstone and shale. The Speaker soil is moderately deep and well drained. It formed in material weathered from sandstone. Soft sandstone is at a depth of 27 inches.

Permeability of the Sanhedrin soil is moderately slow. Available water capacity is 4 to 8 inches. Effective rooting depth is 40 to 60 inches. Permeability of the Kekawaka soil is moderately slow. Available water capacity is 8 to 10 inches. Effective rooting depth is 60 inches or more. Permeability of the Speaker soil is moderately slow. Available water capacity is 2 to 6 inches. Effective rooting depth is 20 to 40 inches.

This unit is used mainly for timber production, wildlife habitat, and watershed.

202 Sanhedrin-Kekawaka-Speaker complex, 30 to 50 percent slopes (1910 Acres)

This map unit is on mountains. Elevation is 2,200 to 4,800 feet. The average annual precipitation is 40 to 60 inches. This unit is about 35 percent Sanhedrin gravelly loam, 30 percent Kekawaka loam, and 15 percent Speaker gravelly loam.

The vegetation is mainly mixed conifers and hardwoods. The vegetation is mainly mixed conifers and hardwoods. Douglas-fir, sugar pine, ponderosa pine, California black oak, and Pacific madrone are the main tree species on this unit. On the basis of a 100-year site curve, the mean site index for Douglas-fir is 121 on the Sanhedrin soil, 154 on the Kekawaka soil, and 107 on the Speaker soil. On the basis of a 100-year site curve, the mean site index for ponderosa pine is 116 on the Sanhedrin soil, 147 on the Kekawaka soil, and 106 on the Speaker soil. The potential annual production of ponderosa pine on the Sanhedrin soil is 530 board feet per acre from a fully stocked stand of trees. The potential annual production of ponderosa pine on the Kekawaka soil is 945 board feet per acre from a fully stocked stand of trees. The potential annual production of ponderosa pine on the Speaker soil is 425 board feet per acre from a fully stocked stand of trees. In many areas, the Kekawaka soil has a rather abrupt boundary between the surface layer and the clay subsoil. In those areas, productivity is much lower; the average site index

Among the common forest understory plants are bedstraw, rose, manzanita, and annual forbs.

Plant competition is a concern in the reforestation and production of timber. When openings are made in the canopy, invading brushy plants that are not controlled can prevent the establishment of seedlings. Reforestation can be accomplished by planting Douglasfir, ponderosa pine, and sugar pine seedlings. If seed trees are present, natural reforestation by conifers frequently occurs. is 106 for Douglas-fir and 113 for ponderosa pine.

The Sanhedrin soil is deep and well drained. It formed in material weathered from sandstone. Sandstone is at a depth of 57 inches. The Kekawaka soil is very deep and well drained. It formed in material weathered from sandstone and shale. The Speaker soil is moderately deep and well drained. It formed in material weathered from sandstone. Soft sandstone is at a depth of 27 inches.

Permeability of the Sanhedrin soil is moderately slow. Available water capacity is 4 to 8 inches. Effective rooting depth is 40 to 60 inches. Permeability of the Kekawaka soil is moderately slow. Available water capacity is 8 to 10 inches. Effective rooting depth is 60 inches or more. Permeability of the Speaker soil is moderately slow. Available water capacity is 2 to 6 inches. Effective rooting depth is 20 to 40 inches.

This unit is used mainly for timber production, wildlife habitat, and watershed.

224 Speaker-Marpa-Sanhedrin gravelly loams, 30 to 50 percent slopes (1169 Acres)

This map unit is on mountains. Elevation is 1,800 to 3,800 feet. The average annual precipitation is 40 to 55 inches. This unit is about 30 percent Speaker gravelly loam, 25 percent Marpa gravelly loam, and 15 percent Sanhedrin gravelly loam.

The Speaker soil is moderately deep and well drained. It formed in material weathered from sandstone. Soft sandstone is at a depth of 27 inches. The Marpa soil is moderately deep and well drained. It formed in material weathered from sandstone. Sandstone is at a depth of 25 inches. The Sanhedrin soil is deep and well drained. It formed in material weathered from sandstone. Weathered sandstone is at a depth of 57 inches.

Permeability of the Speaker soil is moderately slow. Available water capacity is 2 to 6 inches. Effective rooting depth is 20 to 40 inches. Permeability of the Marpa soil is moderate. Available water capacity is 1.5 to 4.0 inches. Effective rooting depth is 20 to 40 inches. Permeability of the Sanhedrin is moderately slow. Available water capacity is 4 to 8 inches. Effective rooting depth is 40 to 60 inches.

The vegetation is mainly mixed conifers and hardwoods. Ponderosa pine and Douglas-fir are the main tree species on the Speaker and Sanhedrin soils. California black oak, interior live oak, and scattered ponderosa pine are the main trees species on the Marpa soil. On the basis of a 100-year site curve, the mean site index is 107 for Douglas-fir and 106 for ponderosa pine on the Speaker soil. On the basis of a 100-year site curve, the mean site index is 103 for Douglas-fir and 105 for ponderosa pine on the Marpa soil. On the basis of a 100-year site curve, the mean site index is 121 for Douglas-fir and 116 for ponderosa pine on the Sanhedrin soil.

Reforestation can be accomplished by planting ponderosa pine seedlings on the Marpa soil and on south-facing aspects. Douglas-fir can be planted on the cooler, north-facing aspects and in most areas of the Sanhedrin soil. If seed trees are present, natural reforestation by ponderosa pine and Douglas-fir is possible. When openings are made in the canopy, invading brushy plants that are not controlled can delay the establishment of seedlings.

Among the common forest understory plants are manzanita, snowberry, rose, and perennial grasses.

This unit is used mainly for timber production, wildlife habitat, and watershed.

225 Speaker-Maymen-Marpa association, 30 to 50 percent slopes (700 Acres)

This map unit is on mountains. Elevation is 1,500 to 4,000 feet. The average annual precipitation is about 35 to 50 inches. This unit is about 30 percent Speaker gravelly loam, 25 percent Maymen gravelly loam, and 25 percent Marpa gravelly loam. The Speaker and Marpa soils are on north and east-facing slopes, and the Maymen soil is on south and west-facing slopes and on ridges.

The Speaker soil is moderately deep and well drained. It formed in material weathered from sandstone or shale. Soft sandstone is at a depth of 27 inches. The Maymen soil is shallow and somewhat excessively drained. It formed in material weathered from sandstone or shale. Hard, fractured sandstone is at a depth of 12 inches. The Marpa soil is moderately deep and well drained. It formed in material weathered from sandstone. Hard, fractured sandstone is at a depth of 25 inches.

Permeability of the Speaker soil is moderately slow. Available water capacity is 2 to 6 inches. Effective rooting depth is 20 to 40 inches. Permeability of the Maymen soil is moderate. Available water capacity is 1 inch to 3 inches. Effective rooting depth is 12 to 20 inches. Permeability of the Marpa soil is moderate. Available water capacity is 1.5 to 4.0 inches. Effective rooting depth is 20 to 40 inches.

The vegetation is mainly conifers and hardwoods on the Speaker and Marpa soils and brush and hardwoods on the Maymen soil. Douglas-fir, ponderosa pine, and California black oak are the main tree species on the Speaker and Marpa soils. On the basis of a 100-year site curve, the mean site index for Douglas-fir is 107 on the Speaker soil and 103 on the Marpa soil. On the basis of a 100-year site curve, the mean site index for ponderosa pine is 106 on the Speaker soil and 105 on the Marpa soil. Among the trees of limited extent are Pacific madrone, sugar pine, and interior live oak. Conifer stands commonly are small and widely scattered, making them generally noncommercial. The natural vegetation on the Maymen soil is mainly brush.

Seedling survival is a concern in the production of timber on this unit. The high soil temperature and low content of soil moisture during the growing season cause mortality of seedlings, especially in areas of the Marpa soil on south- and southwest-facing slopes. Reforestation of the Speaker and Marpa soils can be accomplished by planting ponderosa pine seedlings. Survival of Douglas-fir seedlings is higher if they are planted on north-facing slopes. If seed trees are present, natural reforestation by conifers occasionally occurs. There is a high risk of fire from the surrounding brush-covered soils.

Among the common forest understory plants are mountain brome, California fescue, wild pea, and hoary manzanita.

This unit is used mainly as wildlife habitat and watershed. It is also used for production of timber and firewood.

226 Speaker-Maymen-Marpa association, 50 to 75 percent slopes (11 Acres)

This map unit is on mountains. Elevation is 1,500 to 4,000 feet. The average annual precipitation is 35 to 50 inches. This unit is about 30 percent Speaker gravelly loam, 25 percent Maymen gravelly loam, and 20 percent Marpa gravelly loam. The Speaker and Marpa soils are on north- and east-facing slopes, and the Maymen soil is on south- and west-facing slopes and on ridges. The areas of Rock outcrop are on ridges or side slopes.

The Speaker soil is moderately deep and well drained. It formed in material weathered from sandstone or shale. Soft sandstone is at a depth of 27 inches. The Maymen soil is shallow and somewhat excessively drained. It formed in material weathered from sandstone or shale. Hard, fractured sandstone is at a depth of 12 inches. The Marpa soil is moderately deep and well drained. It formed in material weathered from sandstone. Hard, fractured sandstone is at a depth of 25 inches.

Permeability of the Speaker soil is moderately slow. Available water capacity is 2 to 6 inches. Effective rooting depth is 20 to 40 inches. Permeability of the Maymen soil is moderate. Available water capacity is 1 inch to 3 inches. Effective rooting depth is 12 to 20 inches. Permeability of the Marpa soil is moderate. Available water capacity is 1.5 to 4.0 inches. Effective rooting depth is 20 to 40 inches.

The vegetation is mainly conifers and hardwoods on the Speaker and Marpa soils and brush and hardwoods on the Maymen soil. Douglas-fir, ponderosa pine, and California black oak are the main tree species on the Speaker and Marpa soils. On the basis of a 100-year site curve, the mean site index for Douglas-fir is 107 on the Speaker soil and 103 on the Marpa soil. On the basis of a 100-year site curve, the mean site index for ponderosa pine is 106 on the Speaker soil and 105 on the Marpa soil. Among the trees of limited extent are Pacific madrone, sugar pine, and interior live oak. Conifer stands commonly are small and widely scattered, making them generally noncommercial. The natural vegetation on the Maymen soil is mainly brush.

Seedling survival is a concern in the production of timber on this unit. The high soil temperature and low content of soil moisture during the growing season cause mortality of seedlings, especially in areas of the Marpa soil on south- and southwest-facing slopes. Reforestation of the Speaker and Marpa soils can be accomplished by planting ponderosa pine seedlings. Survival of Douglas-fir seedlings is higher if they are planted on north-facing slopes. If seed trees are present, natural reforestation by conifers occasionally occurs. There is a high risk of fire from the surrounding brush-covered soils.

Among the common forest understory plants are mountain brome, California fescue, wild pea, and hoary manzanita.

This unit is used mainly as wildlife habitat and watershed. It is also used for production of timber and firewood.

229 Speaker-Sanhedrin-Maymen association, 30 to 50 percent slopes (2635 Acres)

This map unit is on mountains. Elevation is 2,100 to 4,000 feet. The average annual precipitation is 40 to 60 inches. This unit is about 30 percent Speaker gravelly loam, 30 percent Sanhedrin gravelly loam, and 20 percent Maymen gravelly loam. The Maymen soil is on west- and south-facing, brush-covered side slopes and ridgetops, and the Speaker and Sanhedrin soils are on east- and north-facing slopes.

The Speaker soil is moderately deep and well drained. It formed in material weathered from sandstone and shale. Soft sandstone is at a depth of 27 inches. The Sanhedrin soil is deep and well drained. It formed in material weathered from sandstone or shale. Weathered sandstone is at a depth of 57 inches. The Maymen soil is shallow and somewhat excessively drained. It formed in material weathered from sandstone or shale. Hard, fractured sandstone is at a depth of 12 inches.

Permeability of the Speaker soil is moderately slow. Available water capacity is 2 to 6 inches. Effective rooting depth is 20 to 40 inches. Permeability of the Sanhedrin soil is moderately slow. Available water capacity is 4 to 8 inches. Effective rooting depth is 40 to 60 inches. Permeability of the Maymen soil is moderate. Available water capacity is 1 to 3 inches. Effective rooting depth is 12 to 20 inches.

The vegetation is mainly mixed conifers and hardwoods and some brush on the Speaker and Sanhedrin soils and brush with some annual grasses on the Maymen soil. Ponderosa pine and Douglas-fir are the main tree species on the Speaker and Sanhedrin soils. On the basis of a 100-year site curve, the mean site index for ponderosa pine is 106 on the Speaker soil and 116 on the Sanhedrin soil. On the basis of a 100-year site curve, the mean site index for Douglas-fir is 107 on the Speaker soil and 121 on the Sanhedrin soil.

Plant competition is a concern in the production of timber. When openings are made in the canopy, invading brushy plants that are not controlled can delay the establishment of seedlings. Reforestation can be accomplished by planting ponderosa pine seedlings on the hotter aspects and Douglas-fir on the cooler, north aspects. If seed trees are present, natural reforestation by ponderosa pine and Douglas-fir occurs periodically.

The natural vegetation on Maymen soil is mainly brush. The species in most areas are mainly chamise, manzanita, and buckbrush.

Among the common forest understory plants are wild pea, bedstraw, snowberry, rose, and annual forbs

This unit is used mainly for timber production, wildlife habitat, and watershed.

230 Speaker-Speaker variant-Sanhedrin association, 5 to 30 percent slopes (562 Acres)

This map unit is on broad ridgetops on mountains. Elevation is 2,200 to 4,000 feet. The average annual precipitation is 40 to 60 inches. This unit is about 30 percent Speaker gravelly loam, 25 percent Speaker Variant loam, and 20 percent Sanhedrin gravelly loam.

The Speaker soil is moderately deep and well drained. It formed in material weathered from sandstone. Soft sandstone is at a depth of 27 inches. The Speaker Variant soil is shallow and well drained. It formed in material weathered from sandstone or shale. Soft sandstone is at a depth of 17 inches. The Sanhedrin soil is deep and well drained. It formed in material weathered from sandstone. Weathered sandstone is at a depth of 57 inches.

Permeability of the Speaker soil is moderately slow. Available water capacity is 2 to 6 inches. Effective rooting depth is 20 to 40 inches. Permeability of the Speaker Variant soil is moderately slow. Available water capacity is 1.5 to 3.5 inches. Effective rooting depth is 10 to 20 inches.

Permeability of the Sanhedrin soil is moderately slow. Available water capacity is 4 to 8 inches. Effective rooting depth is 40 to 60 inches.

The vegetation is mainly mixed conifers and hardwoods and some brush. Among the trees of limited extent are California black oak, Pacific madrone, and sugar pine. Douglas-fir and ponderosa pine are the main tree species on this unit. On the basis of a 100-year site curve, the mean site index for Douglas-fir is 107 on the Speaker soil, 80 on the Speaker Variant soil, and 121 on the Sanhedrin soil. On the basis of a 100-year site curve, the mean site index for ponderosa pine is 106 on the Speaker soil, 80 on the Speaker Variant soil, and 116 on the Sanhedrin soil.

Seedling survival is a concern in the production of timber. Reforestation can be accomplished by planting Douglas-fir seedlings on the cooler aspects and ponderosa pine on the hotter, south aspects. If seed trees are present, natural reforestation of cutover areas by Douglas-fir and ponderosa pine occurs periodically. The high soil temperature and low content of soil moisture during the growing season cause mortality of seedlings, especially in areas of the Speaker and Speaker Variant soils on south- and southwest-facing slopes.

Among the common forest understory plants are wild pea, mountain brome, California fescue, and manzanita.

This unit is used mainly for timber production, wildlife habitat, and watershed.

235 Still-Talmage complex, 2 to 8 percent slopes (60 Acres)

This map unit is on alluvial fans and flood plains. Elevation is 1,300 to 1,800 feet. The average annual precipitation is 25 to 40 inches. This unit is about 55 percent Still gravelly loam and 30 percent Talmage very gravelly sandy loam.

The Still soil is very deep and well drained. It formed in alluvium derived from mixed rock sources, dominantly sandstone or shale. The Talmage soil is very deep and somewhat excessively drained. It formed in alluvium derived from mixed sources.

Permeability of the Still soil is moderately slow. Available water capacity is 7.5 to 9.5 inches. Effective rooting depth is 60 inches or more. Permeability of the Talmage soil is moderately rapid. Available water capacity is 2.5 to 4.5 inches. Effective rooting depth is 60 inches or more.

The vegetation is mainly annual grasses and forbs with scattered oaks.

This unit is used mainly for livestock grazing and hay and pasture

231 Squawrock-Shortyork variant gravelly loams, 15 to 30 percent slopes (165 Acres)

This map unit is on mountains. The Short york soil is susceptible to slumping. Elevation is 2,000 to 4,000 feet. The average annual precipitation is 40 to 60 inches. This unit is about 40 percent Squawrock gravelly loam and 35 percent Shortyork Variant gravelly loam.

The Squawrock soil is moderately deep and well drained. It formed in material weathered from sandstone. Hard, fractured sandstone is at a depth of 37 inches. The Shortyork Variant soil is moderately deep and well drained. It formed in material weathered from metamorphased sandstone and greenstone. Hard, fractured greenstone and metamorphosed sandstone are at a depth of 32 inches.

Permeability of the Squawrock soil is moderate. Available water capacity is 1.5 to 4.5 inches. Effective rooting depth is 20 to 40 inches. Permeability of the Shortyork Variant soil is very slow.

Available water capacity is 1.5 to 4.5 inches.

The vegetation is mainly annual grasses and forbs with a few scattered oaks and conifers. The characteristic plant community on this unit is mainly soft chess and wild oat.

This unit is used mainly for livestock grazing, wildlife habitat, and watershed.

237 Talmage very gravelly sandy loam (210 Acres)

This very deep, somewhat excessively drained soil is on alluvial fans and flood plains and in areas adjacent to drainage ways. It formed in alluvium derived from mixed rock sources. Slope is 0 to 2 percent. Elevation is 1,300 to 1,800 feet. The average annual precipitation is 25 to 50 inches.

Permeability of this Talmage soil is moderately rapid. Available water capacity is 2.5 to 4.5 inches. Effective rooting depth is 60 inches or more.

The vegetation is mainly annual grasses and forbs with scattered oaks. This unit is used mainly for livestock grazing and for hay and pasture. It is also used for orchards and vineyards.

246 Wolfcreek gravelly loam (71

This very deep, well-drained soil is on flood plains. It formed in alluvium derived from mixed rock sources. Slope is 0 to 2 percent. Elevation is 1,300 to 2,600 feet. The average annual precipitation is 25 to 40 inches.

Permeability of this Wolfcreek soil is moderately slow. Available water capacity is 7.5 to 10.0 inches. Effective rooting depth is 60 inches or more.

The vegetation is mainly annual grasses and forbs. The characteristic plant community on this unit is mainly soft chess, filaree, and burclover.

This unit is used mainly for livestock grazing and hay and pasture.

247 Wolfcreek loam (63 Acres)

This very deep, well drained soil is on flood plains. It formed in alluvium derived from mixed rock sources. Slope is 0 to 2 percent. Elevation is 1,300 to 2,600 feet. The average annual precipitation is 25 to 40 inches.

Permeability of this Wolfcreek soil is moderately slow. Available water capacity is 7.5 to 10.0 inches. Effective rooting depth is 60 inches or more.

The vegetation is mainly annual grasses and forbs.

This unit is used mainly for livestock grazing and hay and pasture. It is also used for home site development.

248 Xerofluvents, very gravelly (26 Acres)

This map unit consists of very deep, excessively drained soils on narrow flood plains adjacent to stream channels. These soils formed in alluvium derived from mixed rock sources, dominantly sandstone or shale. Slope is 0 to 2 percent. Elevation is 750 to 1,500 feet. The average annual precipitation is 25 to 40 inches.

Permeability of these soils is rapid. Available water capacity is 1.5 to 2.5 inches. Effective rooting depth is 60 inches or more.

The vegetation is mainly sparse annual grasses and forbs. The characteristic plant community on this unit is mainly 249vinegarweed, foxtail fescue, and filaree.

This unit is used mainly for livestock grazing. It is also used as a source of commercial gravel.

249 Xerofluvents-Riverwash complex (322 Acres)

This map unit is on narrow flood plains adjacent to stream channels and in active stream channels. Slope is 0 to 2 percent. Elevation is 750 to 2,800 feet. The average annual precipitation is 25 to 40 inches. This unit is about 55 percent Xerofluvents and 30 percent Riverwash. Xerofluvents consist of very deep, excessively drained soils that formed in alluvium derived from mixed rock sources. Riverwash is very deep water-deposited sediment consisting of sand, gravel, cobbles, and stones in active stream channels.

Permeability of these soils is rapid. Available water capacity is 1.5 to 2.5 inches. Effective rooting depth is 60 inches or more.

The vegetation is mainly sparse annual grasses and forbs. The characteristic plant community on this unit is mainly foxtail fescue, vinegarweed, and filaree.

This unit is used mainly for livestock grazing and wildlife habitat. It is also used for as a source of commercial gravel.

254 Yorkville-Yorktree-Squawrock association, 15 to 50 percent slopes (215 Acres)

This map unit is on hills and mountains. The soils in this unit are unstable. Slumps and a hummocky relief are common. Elevation is 1,800 to 3,500 feet. The average annual precipitation is 35 to 50 inches. This unit is about 45 percent Yorkville clay loam, 20 percent Yorktree clay loam, and 15 percent Squawrock gravelly loam. The Yorkville soil is on concave slopes, the Yorktree soil is on convex slopes and in drainage ways, and the Squawrock soil is on convex spur ridges surrounding rock outcroppings and in drainage ways. The Yorkville soil is very deep and moderately well drained. It formed in material weathered from graywacke, schist, or shale. Hard, fractured schist is at a depth of 64 inches. The Yorktree soil is deep and well drained. It formed in material weathered from graywacke, schist, or shale. Hard, fractured schist is at a depth of 55 inches. The Squawrock soil is moderately deep and well drained. It formed in material weathered from sandstone. Hard, fractured sandstone is at a depth of 37 inches.

Permeability of the Yorkville soil is very slow. Available water capacity is 8.5 to 13.5 inches. Effective rooting depth is 60 inches or more. Permeability of the Yorktree soil is very slow. Available water capacity is 5.5 to 9.5 inches. Effective rooting depth is 40 to 60 inches. Permeability of the Squawrock soil is moderate. Available water capacity is 1.5 to 4.5 inches.

Effective rooting depth is 20 to 40 inches. The vegetation is mainly annual grasses and forbs with a few scattered oaks on the Yorkville and Squawrock soils and oaks and annual grasses on the Yorktree soil.

The vegetation is mainly annual grasses and forbs with a few scattered oaks on the Yorkville and Squawrock soils and oaks and annual grasses on the Yorktree soil. Among the common understory plants on the Yorktree soil are melicgrass, blue wild rye, and buttercup.

This unit is used mainly for livestock grazing, wildlife habitat, and watershed.

18.0 Marking Guides

Treatment Unit Number	Treatment Description	Logging System	Acres	Activity Fuels Treatment[1]	Snag Retention Guidelines	Coarse Woody Debris (CWD)	Project Design Features SMZ[2], Springs, Unstable Areas, Wet Areas
1	Commercial Salvage	Ground/Cable	59	Apply treatments 1, 2, 3, 4,or 5	Refer to the Silviculture Report for detailed guidance	Refer to the Silviculture Report for detailed guidance	No Ground Equipment in SMZ for watercourses or springs; exclude 1.6 acre inner gorge from heavy machinery and harvest
2	Commercial Salvage	Ground	25	Apply treatments 1, 2, 3, 4,or 5	Refer to the Silviculture Report for detailed guidance	Refer to the Silviculture Report for detailed guidance	No Ground Equipment in SMZ for watercourses or springs
3	Commercial Salvage	Ground	52	Apply treatments 1, 2, 3, 4,or 5	Refer to the Silviculture Report for detailed guidance	Refer to the Silviculture Report for detailed guidance	No Ground Equipment in SMZ for watercourses or springs; exclude 2.3 acre inner gorge from heavy machinery and harvest
4	Commercial Salvage	Ground	52	Apply treatments 1, 2, 3, 4,or 5	Refer to the Silviculture Report for detailed guidance	Refer to the Silviculture Report for detailed guidance	No Ground Equipment in SMZ for watercourses or springs;

Treatment Unit Number	Treatment Description	Logging System	Acres	Activity Fuels Treatment[1]	Snag Retention Guidelines	Coarse Woody Debris (CWD)	Project Design Features SMZ[2], Springs, Unstable Areas, Wet Areas
5	Commercial Salvage	Ground	42	Apply treatments 1, 2, 3, 4,or 5	Refer to the Silviculture Report for detailed guidance	Refer to the Silviculture Report for detailed guidance	No Ground Equipment in SMZ for watercourses or springs; exclude 0.54 acre inner gorge from heavy machinery and harvest
6	Commercial Salvage	Ground	19	Apply treatments 1, 2, 3, 4,or 5	Refer to the Silviculture Report for detailed guidance	Refer to the Silviculture Report for detailed guidance	No Ground Equipment in SMZ for watercourses or springs; exclude 2.4 acre inner gorge from heavy machinery and harvest
7	Commercial Salvage	Ground	158	Apply treatments 1, 2, 3, 4,or 5	Refer to the Silviculture Report for detailed guidance	Refer to the Silviculture Report for detailed guidance	No Ground Equipment in SMZ for watercourses or springs; exclude 4.6 acre inner gorge from heavy machinery and harvest
8	Commercial Salvage	Ground	25	Apply treatments 1, 2, 3, 4,or 5	Refer to the Silviculture Report for detailed	Refer to the Silviculture Report for detailed	No Ground Equipment in SMZ for watercourses

Treatment Unit Number	Treatment Description	Logging System	Acres	Activity Fuels Treatment[1]	Snag Retention Guidelines	Coarse Woody Debris (CWD)	Project Design Features SMZ[2], Springs, Unstable Areas, Wet Areas
					guidance	guidance	or springs;
9	Commercial Salvage	Ground/Cable	48	Apply treatments 1, 2, 3, 4,or 5	Refer to the Silviculture Report for detailed guidance	Refer to the Silviculture Report for detailed guidance	No Ground Equipment in SMZ for watercourses or springs; exclude 2 acre inner gorge from heavy machinery and harvest
10	Commercial Salvage	Ground	28	Apply treatments 1, 2, 3, 4,or 5	Refer to the Silviculture Report for detailed guidance	Refer to the Silviculture Report for detailed guidance	No Ground Equipment in SMZ for watercourses or springs;
11	Commercial Salvage	Ground	19	Apply treatments 1, 2, 3, 4,or 5	Refer to the Silviculture Report for detailed guidance	Refer to the Silviculture Report for detailed guidance	No Ground Equipment in SMZ for watercourses or springs;
12	Commercial Salvage	Ground	34	Apply treatments 1, 2, 3, 4,or 5	Refer to the Silviculture Report for detailed guidance	Refer to the Silviculture Report for detailed guidance	No Ground Equipment in SMZ for watercourses or springs;

Treatment Unit Number	Treatment Description	Logging System	Acres	Activity Fuels Treatment[1]	Snag Retention Guidelines	Coarse Woody Debris (CWD)	Project Design Features SMZ[2], Springs, Unstable Areas, Wet Areas
13	Commercial Salvage	Ground	11	Apply treatments 1, 2, 3, 4,or 5	Refer to the Silviculture Report for detailed guidance	Refer to the Silviculture Report for detailed guidance	No Ground Equipment in SMZ for watercourses or springs;
14	Commercial Salvage	Ground	11	Apply treatments 1, 2, 3, 4,or 5	Refer to the Silviculture Report for detailed guidance	Refer to the Silviculture Report for detailed guidance	No Ground Equipment in SMZ for watercourses or springs;; exclude 0.34 acre inner gorge from heavy machinery and harvest
Geology notes:							
Inner gorges are streamside slopes greater than 65%; in units 1, 3, 5, 6, 7, 9, 14							
No known active landslides in any salvage units. Subject to change as new slides or reactivated slides can happen at any time.							
[1] 1 = Ground Based: Whole Tree Yard or Yard Tops or Cable Based: Yard last log with top attached, 2 = Hand or Machine Pile, 3= Burn Piles , 4 = Underburn, 5 = Lop and Scatter							
[2] SMZ = Streamside Management Zone, Perennial streams- 100 feet each side, Intermittent streams- 50 feet each side, Ephmeral Streams- 20 feet each side							